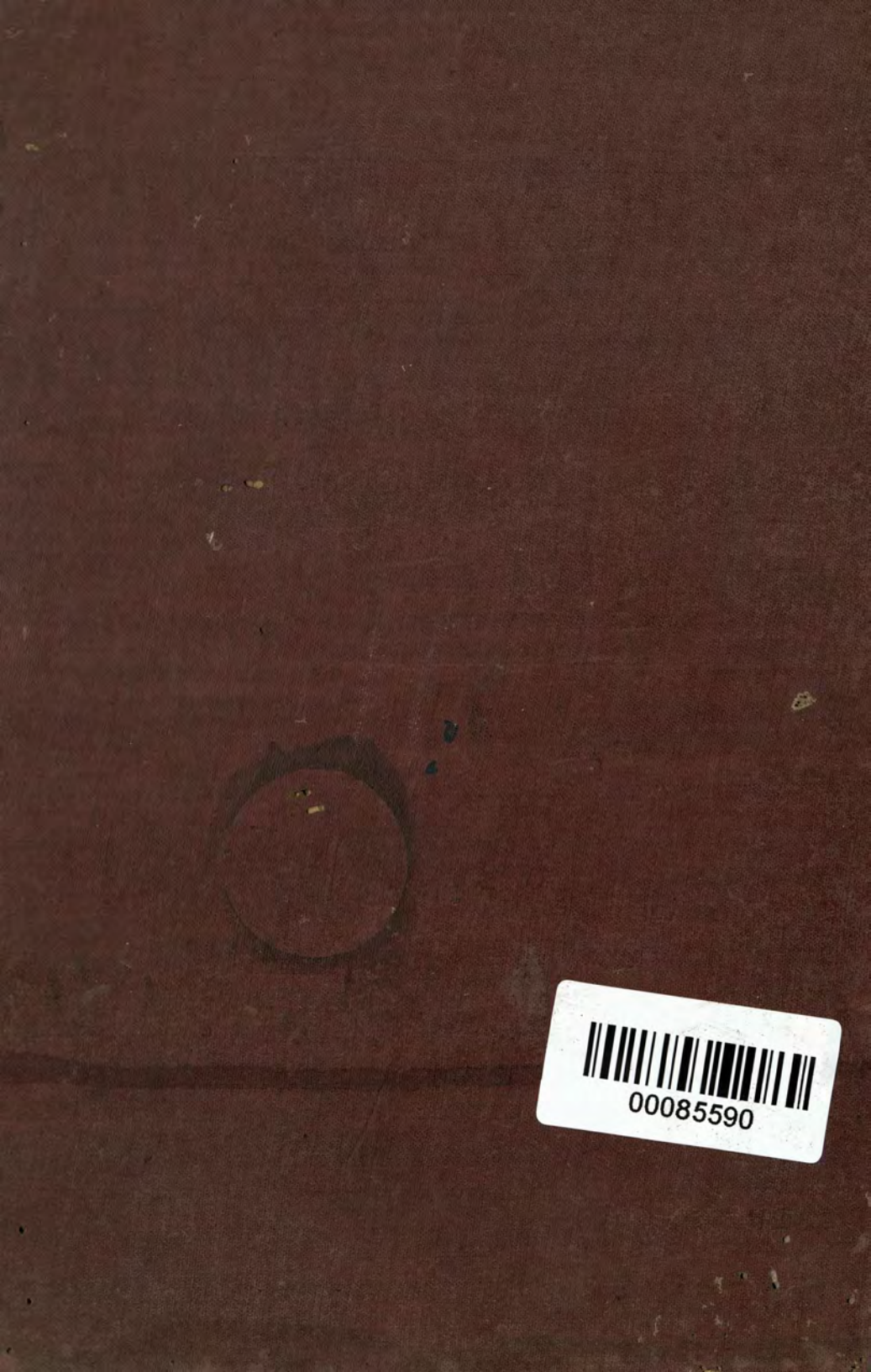
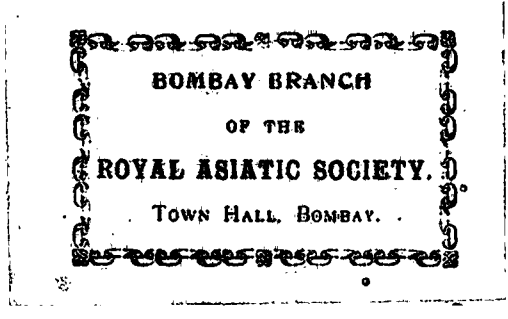

00085590



Digitized with financial assistance from the
Government of Maharashtra
on 23 March, 2016



James D. Forbes. del. J. McEwan lith.

Day & Son, Lith.rs to the Queen.

GLACIER OF BONDHUUS

NORWAY

AND ITS GLACIERS

VISITED IN 1851;

FOLLOWED BY

JOURNALS OF EXCURSIONS

IN THE HIGH ALPS OF DAUPHINÉ,

BERNE, AND SAVOY.

2-k-11 E559a

BY

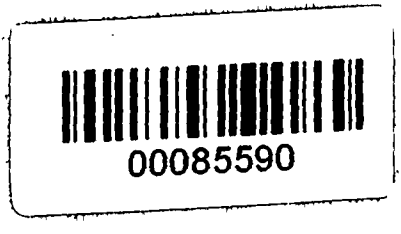
JAMES D. FORBES, D.C.L., F.R.S., Sec. R.S. Ed.

CORRESPONDING MEMBER OF THE INSTITUTE OF FRANCE,
AND OF OTHER ACADEMIES; AND PROFESSOR OF NATURAL PHILOSOPHY IN THE
UNIVERSITY OF EDINBURGH.



EDINBURGH:
ADAM AND CHARLES BLACK.
MDCCCLIII.

914.81
Fos/NOS
85590



EDINBURGH: PRINTED BY R. AND R. CLARK.

TO

PROFESSOR LANGBERG

OF THE UNIVERSITY OF CHRISTIANIA,

THIS VOLUME IS DEDICATED,

IN TOKEN OF RESPECT FOR HIS CHARACTER AND ATTAINMENTS,

AS WELL AS

IN GRATEFUL ACKNOWLEDGMENT OF HIS

UNWEARIED KINDNESS.

CONTENTS.

PAGE

PRELIMINARY CHAPTER xvii

NORWAY.

CHAPTER I.

HULL TO CHRISTIANIA—CHRISTIANIA TO THE DOVRE-FIELD . . .

The Lindesnaes—Aspect of the Norwegian Coast—The Christiania Fiord—Town of Christiania—Its Position—Appearance—Pretensions—Character of its Climate—Aspect of Surrounding Country—Departure for Throndhjem (Drontheim)—Carriole Travelling—The Miösen Lake—Gulbrandsdal—Remarkable Absence of Villages in Norway—Inn at Tofte—Ascent of Dovre-Field—Its Aspect—Arrive at Jerkind.

CHAPTER II.

SNEEHÆTTAN—DOVRE-FIELD TO THRONDHJEM (DRONTHEIM) 19

Route from Jerkind to Sneehættan—The Ascent—Height of Sneehættan—The View from the Top—Return to Jerkind—Kongsvold—The Vaarstige—Action of Glaciers—Maintenance of the Roads in Norway—Travelling in Spring—Drivstuen—Aamoseiv—Geology of the Dovre-Field according to Naumann—The Rivers Oerkel and Gaul—Throndhjem.

CHAPTER III.

PAGE

NORDLAND 39

Character of Northern Norway — Leave Throndhjem by Steamer — Vaers — Torghattan — Its Cavern — Roches Moutonnées—Yachts—The Seven Sisters—Œxtind—Enter the Arctic Circle—Glaciers of Fondal—Bodö—Scenery of Vest-Fiord and the Lofodden Islands—Arrival at Tromsö.

CHAPTER IV.

FINMARKEN. 68

Tromsö—Visit to Lapp Encampment—Voyage continued—Ulfs-Fiord — Lyngen-Fiord — Pippertind Glacier — Skjærvö — Glacier of Kaagen — Qvenanger-Fiord and Mountains—Serene Midnight—Jökuls-Field and Glaciers —Arrival at Kaa-Fiord (Alten)—Climate—Character of the Country—Excursion to Bosekop and Alten River—The Quaens—Return Voyage.

CHAPTER V.

BERGEN 99

Leave Throndhjem — Molde — Aalesund — Horneln—Entrance of Sogne-Fiord — Glacier Markings—Singular Passage of Alversund—Arrival at Bergen—Aspect and Situation of the Town—Climate—Total Eclipse of the Sun on the 28th July 1851—Ancient Total Eclipse at Stiklastad.

CHAPTER VI.

THE HARDANGER-FIORD 119

Land Journey to Oos—Oos to Teroe—Reception at the Inn — Kvindherred-Fiord-Rosendal — Traces of Ancient Glaciers—Method of catching Salmon—Moranger-Fiord Bondhuus—The Glacier and its Moraine—Oevrehuus—Passage of the Glacier of the Folgefond to Tockheim—Odde—The Sör-Fiord—Ullensvang—Utne—Graven—Scenery—Vossevangen.

CHAPTER VII.

PAGE

THE SOGNE-FIORD 143

Vinje to Gudvangen—The Nærœ-Fiord—Singular and Wild Scenery—Lekanger—The Systrand—Fjærlands-Fiord and its Glaciers—Reach Stölum—The Suphelle Glacier described—Its remarkably Low Level—Return to Lekanger—Standing Stones of Nargla—Sogndal—Ancient Moraine—Geology and Fine Scenery—Solvorn on the Lyster-Fiord—Rönneid—Arrive at Justedal.

CHAPTER VIII.

JUSTEDAL—THE FILLEFIELD 160

The Krondal—Glacier of Berset—Its Veined Structure—Dirt-Bands—And probable Annual Progress—Its Moraines—Modern Decrease of the Glaciers of Justedal—Leave the Krondal—Remarkable Roches Moutonnées—Nygaard Glacier—Its Position and Size—Its Structure compared to the Swiss Glaciers—Its Ancient Moraines—Return to Solvorn—Scenery of the Sogne-fiord to Lærdalsören—Carriole Journey to Christiania—Farther remarks on Travelling in Norway—Church at Borgund—The Fillefield—Little Miösen Lake—Arrive at Christiania—Return to England.

CHAPTER IX.

ON SOME POINTS IN THE PHYSICAL GEOGRAPHY OF NORWAY, CHIEFLY CONNECTED WITH ITS SNOW-FIELDS AND GLACIERS . 185

Introductory Remarks. § 1. On the Configuration of Norway—Its Ground Plan—Its Mountainous Districts or Fields are usually Plateaux—Large Proportion of Elevated Area—The Kjölen Mountains—Their existence denied by some Geographers—Three Sections of Norway. § 2. On some peculiarities of the Climate of Norway—Less severe than commonly supposed, or than any other Land in the same Parallel—The Causes of this—The Summer and Winter Curves of equal Temperature—Contrast of

PAGE

the two sides of the Peninsula. § 3. On the Position of the Snow-Line in Norway—Mainly determined by the Summer Temperature—Particulars of Observations on the Subject—On the Limit of Growth of the Birch—Influence of the Sea in depressing the Snow-Line—Table of Results.

CHAPTER X.

ON SOME POINTS IN THE PHYSICAL GEOGRAPHY OF NORWAY, CHIEFLY CONNECTED WITH ITS SNOW FIELDS AND GLACIERS—*Continued from Chapter* IX. 217

§ 4. Essay towards an Enumeration of the Principal Snow Fields and Glaciers of Norway. § 5. The Glaciers of Norway compared with those of Switzerland—Analogy perfect—Differences less than might be expected from Difference in Latitude—Due chiefly to the different Relief of the Country. § 6. On the former Extension of Glaciers in Norway—Moraines of Ancient Glaciers first described by Esmark—Similar to those of Switzerland and other Countries—Change of Climate necessary to cover Norway with Snow and Ice not Excessive. § 7. On some Observations desirable to be made. § 8. On some peculiarities of the Scenery of Norway—Waterfalls.

EXCURSIONS IN THE ALPS.

CHAPTER I.

NARRATIVE OF EXCURSIONS IN THE ALPS OF DAUPHINÉ IN 1839 AND 1841 255

Boundaries of the District described—Mountains of Oisans—Their Geological Peculiarities—Hot Springs—Allevard—Les Sept Laux—Allemont—Bourg d'Oisans—Valley of the Romanche—Valley of St. Christophe—Venos—Fall of a Mountain—Village of St. Christophe—Scene from Les Etages—Mont Oursine—Hamlet of La Berarde.

CHAPTER II.

PAGE

EXCURSIONS IN THE ALPS OF DAUPHINÉ—*Continued* 274

Cross the Col de Sais, exceeding 10,000 feet—Glacier de la Condamina—Descent to La Chapelle—Passage of the Col de Celar—Glacier and Dangerous Precipices—Entraigues—Ville de Val Louise—Mont Pelvoux—Monestier—Col de Lautaret—Superposition of Gneiss to Lias—La Grave—The Scenery—Combe de Malaval—Passage of the Col des Infernets—Remarks on the Geology of the Montagnes de l'Oisans.

CHAPTER III.

EXCURSION ON THE GLACIERS OF THE BERNESE ALPS, PRECEDING THE ASCENT OF THE JUNGFRAU 296

Engagement with M. Agassiz—Residence on the Glacier of the Lower Aar—Topography of the Bernese Oberland and the Glaciers originating near the Finsteraarhorn—Two Panoramas—Excursion from the Grimsel to Glacier of Aletsch in Valais—Departure—The Glacier and Col of the Oberaar—Descent on the Glacier of Viesch—Caverns in the Névé—Enormous Block of Stone on the Moraine—Arrival at the Châlets of Märjelen—Preparation for the Ascent of the Jungfrau.

CHAPTER IV.

THE ASCENT OF THE JUNGFRAU 323

History of attempts to ascend the Jungfrau—Departure from the Châlets of Märjelen—Lake and Glacier of Aletsch—Prospect of the Range of the Jungfrau—The Firn or Névé—The Ascent commences—Passage of the Great Crevasse—Col of the Roth Thal reached—Final ascent of 800 feet on a Slope of Ice—The Summit described—The View, and Stupendous Cloud—Return to the Châlets by Moonlight—The lower portion of the Glacier of Aletsch described—Its termination in the Ravine of Naters—Arrival at Briegg.

CHAPTER V.

PAGE

NARRATIVE OF THE PASSAGE OF THE COL DE SALENA, FROM THE VALLEY OF CHAMOUNI TO THAT OF FERRET IN 1850 . . 330

Peculiarities of the Chain of Mont Blanc—Glacier of Le Tour little visited—Leave the Col de Balme—Ascend the Glacier—Its Features—Attain the Ridge—Its unexpected Elevation—Exceeds the Col du Géant—Proposed as an Experimental Station—Descent on the Glacier of Salena—Fine Protogine—Topography—Difficult Route—Sudden Fog—Extrication—Reach Orsières in the Val Ferret.

LIST OF ILLUSTRATIONS.

MAPS.

PAGE

Map of Norway, shewing the general Distribution of Perpetual Snow . . . . . *At the end of the Volume.*

Map of the Ymes-field 225

LITHOGRAPHIC VIEWS.

Glacier of Bondhuus . . . . . *Frontispiece.*

Vaarstige, Dovre-Field 31

Mountains near Folden-Fiord 58

Rafte-sund, Lofodden 63

Qvenanger Tindefne 78

Glaciers of the Nus-Fiord 81

Suphelle Glacier, Fjærland 150

Nygaard Glacier, Justedal 167

Valley of La Berarde, Dauphiné 270

The Jungfrau, from the Glacier of Aletsch 315

WOOD ENGRAVINGS.

Entrance of the Rafte-sund, Lofodden xvii

Torghattan 39

Lovunden and Threnen Islands 50

Extind 51

	Page
Blaamands-Field	56
Lapp Encampment	68
Kaagen Island	77
Kaa-Fiord, from Mr. Thomas's House	86
Terraces at Quaenvig	92
The Fjærlands-Fiord	143
Sogndals-Fiord, from Nargla Tune	154
Plan of the Glaciers of Krondal	165
Little Miösen Lake	182
Three Sections of Scandinavia	197
Scene at La Berarde, Dauphiné	255
Mont Pelvoux, from Val Louise	274
The Bernese Alps from the North and South	301
Section of a Crevasse	317
Sketch of the Top of the Jungfrau	321
Plan of ditto	321
The Glacier du Tour, from the Aiguille de la Glière, Chamouni	330
Plan of the Glacier of Salena	335

CORRECTIONS AND ADDITIONS.

Page 5. I have, it seems, over-estimated the population of Christiania. Mr. A. K. Johnston states that at the latest census in 1845 it was only 31,703.

Page 209. On the snow limit at Sulitelma. I find that in Wahlenberg's original work (*Berättelse*, page 48), the snow line is fixed at 4100 French feet at Quickjock, on the *east* of the Sulitelma range, and at 3100 on the *western* slopes. The mean, or 3600 feet, is evidently the authority for Von Buch's 1169 metres. I am still rather at a loss to reconcile this with Wahlenberg's own statement of four years' later date, which I have quoted in the text from his Flora Lapponica that 3300 is the average height of the snow line in Lapland. If so, the observation at Quickjock must be exceptional. On the whole, we may perhaps admit that the adopted snow line in the text is somewhat underrated for lat. 70°.



ENTRANCE OF THE RAFTE-SUND, LOFODDEN ISLANDS.—See p. 62.

I AM anxious that the intention of this work should not be misunderstood.

None I hope will suspect me of the presumption of writing a systematic account of a country like Norway—so vast in extent, so difficult to explore, and so full of interest—founded on the impression of only a single summer's tour. The journey had been looked forward to for many years. When accomplished, it was with an unavoidable restriction as to time; I had no thoughts of publishing a book as the result. Should I succeed in acquiring information of any value on the formation of glaciers in Norway (a subject to which I had previously devoted much attention) a paper communicated to one of our scientific societies, and printed

in their transactions, seemed all that was desirable for making it known. To this course, however, an objection occurred from the nature of the materials I had collected. Not the least important part of these (as I considered) was a series of sketches of the glaciers and snow fields of Norway throughout the entire range of latitude in which they occur, namely, between the 60th and 70th parallels. Of these I know of only one that has been engraved, or rather lithographed, so as to give any idea of this great natural feature of Scandinavia. I did not think it reasonable to request any of our publishing societies to give these illustrations in the careful and expensive style which I thought requisite.

In the meantime, anxious to preserve all the impressions I could of a hasty, but to me most interesting and suggestive journey, immediately on my return home I began to extend my notes and to compare and correct my inferences by studying some of the best topographical works, particularly the *Gœa Norvegica* of Keilhau and his colleagues. This occupation I continued and completed as an agreeable employment during a tedious convalescence from illness. When it was finished, I reverted to the idea of describing the glaciers of Norway, with the aid of sufficiently detailed landscape illustrations. I explained the circumstances to the Messrs. Black of Edinburgh, the enterprizing publishers of my former work on the Alps, who willingly undertook the publication both of MS. and Plates, exactly in the form which I requested of them. During printing, the earlier chapters have been somewhat expanded, so as to take off some of the meagreness of the original notes, at the risk of repeating occasionally information to be found in previous books of travels.

Had it seemed at all probable that I might return to Norway and prosecute my enquiries with all the incomparable advantages of a second visit—first impressions having been defined and corrected by intermediate study—I should probably have avoided publication, at least in this form. But a pretty long experience in such matters has convinced me that they act wisely and well, who, having used their opportunities to the best of their power, communicate the results of their observations to the world without waiting for a period (never perhaps to arrive) when they may themselves have the credit of completing and perfecting them. It is better, whilst the freshness of recollection is undimmed—and the mind is in a position to draw a correct parallel between older and quite recent observations, and thus give to our descriptions the necessary development—to throw into them whatever there may be of value in our peculiar experience or habits of investigation, and frankly to invite our fellow labourers to do in our stead what we would gladly have done but for some inevitable want of health, leisure, or opportunity. Were this course more generally followed in the sciences, both of observation and experiment, I am persuaded that, by grasping at less we should attain more—even in personal reputation—and should unquestionably advance the interests of knowledge.

It is with feelings thus unambitious that I submit these pages to the reader. If the journey was too rapid to allow of my accomplishing a great deal, it yet enabled me to see distinctly how much remains to be done to promote our acquaintance with the physical geography of Norway, even in the more limited aspects in which it is considered in the present work. Much indeed has been done by the labours of the excellent geologists and geographers whom Norway

still possesses, by Keilhau, by Munch, by Vibe, as well as by Esmark, Christian Smith, and Hertzberg, whom she has lost. Scandinavia has produced one physical geographer of the first order, Wahlenberg, the De Saussure of the north, and his labours were worthily extended by the penetrating and gifted Leopold von Buch; but there is still room for more to be done, especially with reference to the progress of science in the last forty years. The climate of Norway, one of the most interesting in the world, has been very partially ascertained, though a slight impulse from the scientific authorities at Christiania would readily establish a chain of meteorological stations. The size of the country is so immense, and, in many parts, objects of interest are so thinly scattered, that it is to the Norwegians themselves that we look for fuller information as to the topographical intricacies of vast *fields* and *fiords* which are at present hardly known, and which yet unquestionably include many interesting peculiarities.* The highest mountain in Norway, the Galdhöpiggen or Ymes-field, if it be indeed the highest, has been known but a few years, and is as yet measured, I believe, only by estimation. There are many glaciers which probably no man of science or intelligent traveller has ever seen, and amongst these it is *possible* that there may be some larger than any now known in Norway, or presenting other remarkable peculiarities. One which I have myself described, perhaps for the first time (the Suphelle-Brae), possesses singularities such as I have nowhere else seen.

* Some materials exist, generally but little known, in the form of local periodical works of a statistical or scientific character, published at Christiania, in the Danish language. For a reference to, and extracts from some of the more interesting of these, I am indebted to the kindness of my friends there.

I have effaced from these pages nearly all that was gratefully recorded in my notes of the individual instances of generous hospitality and friendly interest which are extended throughout Norway to even the passing stranger, with unstinting hand and heart. In one or two instances, where the individuals acted in an official as well as private capacity, I have allowed myself to mention names. And I take advantage of the exception to express my sincere acknowledgments to Mr. Crowe, the worthy representative of England as Consul-General at Christiania, and to his family, for the unwearied kindness and important assistance which I received from them during both my visits to the capital. In the case of private Norwegian gentlemen, I feel that I have no right to mention names, or to describe them by implication. I know that their delicacy shrinks from it, and that they consider their traditional hospitality as a privilege, and not as constituting a debt, least of all one which can be cancelled by its mere publication. Of society, therefore, as I saw it in Norway, I shall not be expected to say anything except in the most general terms.

But I may here express my frank acknowledgments for the important information respecting the physical geography of Norway, and its snow-fields in particular, which has been courteously communicated to me (chiefly from unpublished sources) by Professors Munch, Keilhau, and Langberg of Christiania, and by Captain Vibe of the Norwegian Royal Engineers. Though the ninth and tenth chapters of this work were written before much of this information reached me, they have been since thoroughly revised, and much additional information has been added in the form of footnotes. On the whole, it is not presumptuous to believe that these chapters contain nearly the sum of

what is *yet* known connected with the snow-line and existing glaciers in Norway. It is to the liberality of my friends at Christiania that it owes this completeness.

In the spelling of names of places, I have usually followed the *Gœa Norvegica*, though not invariably; nor is that work always consistent throughout. In fact, in a country like Norway, many names are spelt merely by ear. The northern capital, Drontheim, as it is usually called in England, I have written as I find it in official documents, Throndhjem. The words *fjeld* and *fjord*, so frequent in the composition of local names, signifying *mountain*, and *lake* or *firth*, I have written *field* and *fiord*, as more conformable to English usage, though it may be questioned whether it is desirable to do so. I may observe, in passing, that *j* in Danish or Norwegian is always equivalent to the English *y*, and that the harsh-looking combination *hj* has nearly the same sound. In attempting to pronounce the language, the beginner should also bear steadily in mind that *aa* has the power of *o* in *cold*.

A considerable number of heights have been approximately ascertained in Norway (nearly all by the barometer), and many of these are referred to in this work. The old Norwegian, which is almost the same as the German or Rhenish foot, is almost exactly *three per cent.* longer than the English foot, and this proportion has been used in the reductions, and the heights given merely to the nearest Ten feet. Indeed, greater nicety would have been absurd, as very few heights in Norway are ascertained within 50 feet, and probably the greater part not within 100. The Norsk mile is equal to about *seven* English.

In every case, *where miles or feet are mentioned in this work without farther qualification, English miles and feet are*

intended. Fahrenheit's scale is also used for the thermometer.

As a principal object of these pages has been to connect my observations on the glaciers of Switzerland and Savoy with those which I have made in the north of Europe, I have thought it a suitable addition to the volume to incorporate three narratives of alpine journeys of older date, which all refer to the wildest and most ice-bound regions of that noble chain. These were written at the time the journeys were made, or soon after, in the same detail, and nearly in the same words as they are now presented to the reader. They seemed to me to be worthy of preservation, and I am not likely to find a more natural occasion for publishing them. The first excursion—that in the Alps of Dauphiné—refers to a region as little known as the remoter parts of Norway itself. The Mont Pelvoux, the highest between Mont Blanc and the Mediterranean, of which I made the circuit nearly twelve years ago, is indeed as little frequented now as it was then. The narrative of the ascent of the Jungfrau, performed the same year in company with M. Agassiz, is now for the first time printed nearly *verbatim* from my journals. The account of the crossing of the chain of Mont Blanc by an undescribed pass higher than the Col du Géant, may be considered as a supplement to my former researches in Savoy. This journey was of much later date than the two former ones; and, indeed, was the last which I made in the Alps.

The illustrations in this volume are all taken from my own sketches. My thanks are certainly due to Mr. Charles Haghe, for the extraordinary fidelity, as well as skill, with which they are transferred to stone. I may safely affirm, that if there be any exaggeration in these plates, it is I who

am responsible for it;* but I believe there is not. I fear that I cannot speak with quite equal confidence as to the wood-cuts, in a few of which the outlines have not been correctly rendered.

The map of Norway accompanying the volume has been constructed with reference not only to the tour, but to the account of the Physical Geography, in Chapters IX. and X. It will be found, I believe, to give a more correct representation both of the outlines and relief of the country, than is to be found in many maps of more pretension.

I shall gratefully receive, through my Publishers, information respecting matters on which I have expressed myself doubtfully, or have recommended to the research of others; still more, of course, on those, concerning which I may have inadvertently made mistakes.

JAMES D. FORBES.

Clifton, Bristol, May 1853.

* Neither Mr. Haghe nor myself are altogether answerable for the *precise* tints used in printing. I regret to observe that, in some copies at least, the colour of two of the illustrations has been accidentally overcharged.

CHAPTER I.

HULL TO CHRISTIANIA—CHRISTIANIA TO THE DOVRE-FIELD.

THE LINDESNAES—ASPECT OF THE NORWEGIAN COAST—THE CHRISTIANIA-FIORD—TOWN OF CHRISTIANIA—ITS POSITION—APPEARANCE—PRETENSIONS—CHARACTER OF ITS CLIMATE—ASPECT OF SURROUNDING COUNTRY—DEPARTURE FOR THRONDHJEM (DRONTHEIM)—CARRIOLE TRAVELLING—THE MIÖSEN LAKE—GULBRANDSDAL—REMARKABLE ABSENCE OF VILLAGES IN NORWAY—INN AT TOFTE—ASCENT OF DOVRE-FIELD—ITS ASPECT—ARRIVE AT JERKIND.

I LEFT England in the Courier steamship, bound from Hull to Christiania, in the night of the 21st June 1851. After a stormy passage across the North Sea, the coast of Norway was in view early on the morning of the 24th. Notwithstanding a heavy sea from the north-west, we made the headland of Lindesnaes with precision, and were soon in comparatively smooth water. It was with great interest and curiosity that I surveyed the southern coast of Norway, about Christiansand and Arendal. The first impression was rather one of disappointment. The character of the scenery here is remarkably monotonous. Hills of a thousand feet high, or less, devoid of boldness, and with but few and narrow intervening valleys, form the mainland—whilst a multitude of small islands, which range along the coast, are undistinguishable from it when viewed

from the sea, owing to the want of any decided relief or variety of character.

The gloomy weather added, no doubt, to the monotony of the scene; and our distance from the shore being greater than I at first sight believed, led me to underrate the elevation of the land. It was only by observing how slowly objects seemed displaced by the motion of the ship, that I became aware of the real scale of the country which I now saw for the first time; and on closer observation, I perceived that the low, rounded, and rocky hills, which I at first had believed to be bare, were almost everywhere covered, or at least dotted over, with woods of pine, which, descending almost to the shore, gave a peculiarity of character to the scenery, at the sametime that it afforded a scale by which to estimate its magnitude. These forests distinguish this part of Norway from those of the Hebrides, which it in other respects resembles. The gneiss islands of Tiree and Coll occurred to my mind the moment that I saw the Norwegian coast, which is less than a degree and a-half of latitude farther north, and doubtless the same causes have produced the similarity of character, acting in like circumstances. Both belong to that great gneiss formation so prevalent in Norway, and also in Scotland, with which few rocks can compare in their resistance to atmospheric action and mechanical force. In both cases they have been subjected for ages to the action of the most tremendous seas which wash any part of Europe, and they have probably been abraded by mechanical forces of another kind, which have given the rounded outlines to even the higher hills, but the exact nature of which is yet subject to great doubt.

The same wooded and undulating character prevails

all the way to Christiania. The entrance of the Christiania-fiord is marked by a lighthouse on the island of Færder, which singularly resembles Inchkeith in the Firth of Forth; but the short night had set in long before we reached the capital. On my return southwards I saw the fiord more perfectly. My impression, however, was the same, that its beauty has been overrated. The monotony of the forms, the continuity of the woods, the absence of almost the smallest sea-cliff or sandy bay, weary the eye, even though the scene is continually changing, and the shores ever verdant. An exception must be made, however, in favour of the immediate environs of Christiania, where the fiord expands into an exceedingly irregular basin, the coasts are steeper, and, at the sametime, varied by the aspect of cultivation and of deciduous trees; where numerous detached houses enliven the low grounds, and the more distant hills have a bolder character.

Christiania itself is seen to advantage from the fiord, as well as from many places in its environs. It is built on an agreeable slope, facing the south. Its suburbs are intermingled with wood. The old castle of Aggershuus, picturesque in form, adorned with fine trees, and standing on a bold promontory, commanding at once the fiord and the greater part of the town, has a striking effect. The city graduates into the country by means of innumerable villas, built usually in commanding situations, which remind one of the environs of Geneva. Indeed, there is something in the entire aspect of the town and surrounding scenery, which is exceedingly pleasing and peculiar. The traveller who is acquainted with the aspects of middle and southern Europe finds himself at a loss to draw a comparison. The clearness of the air, the warmth of the sun, and a certain

intensity of colour which clothes the landscape, involuntarily recall southern latitudes, and even the shores of the Mediterranean. But the impression is counteracted by the background of pine forest, which reminds him of some of the higher and well-wooded cantons of Switzerland, to which the varied outline of the fiord—which may compare, in irregularity with the lake of the four cantons—lends an additional resemblance; yet again we miss the background of alpine peaks and perpetual snows.

Wherever the traveller may choose to fancy himself, his last idea would probably be (what is really the fact) that he is here in the latitude of the Shetland Islands, nearly in the parallel of Lerwick, and a degree north of Kirkwall. Some tourist, in a moment of spleen, has chosen to draw a comparison between the county town of Orkney and the capital of Norway, in favour of the former; but the comparison is too absurd to be regarded as more than a jest—the only point of superiority of Kirkwall, its noble cathedral (which it owes besides to a Norwegian architect and Norwegian builders), being quite incapable of concealing the manifest inferiority in every other quality of beauty, greatness, or convenience, granted by nature, or attained by art. Every one naturally refers what he sees in other countries to the standard of home, and the contrast of southern Norway to the extreme northern parts of Great Britain, came upon me perpetually, with a force which added great zest to the scenery of a country already in all respects new to me. Shetland, treeless and bare, covered for the most part with morasses, and abounding in inaccessible cliffs, is enveloped, even in summer, by frequent fogs, and rarely enjoys an entire day of sunshine; in winter, on the other hand, it boasts of a climate as mild as

that of Avignon, and little colder in the month of January than Florence, which is 17° farther south—its capital little better than a fishing village with one street, which a carriage, (did carriages exist) could with difficulty traverse. But here, on the same parallel, and only 12° of longitude farther east, we see the Aggershuus Amt, in which Christiania is placed, verdant with superabundant forests, not only of spruce and pine, but with nearly all the ordinary trees of an English demesne—the plane and sycamore, the ash and elm, and even (though more rarely), the beech and oak, growing to a full stature and luxuriant in foliage, besides all common kinds of fruit-trees * and flowering shrubs, such as lilac, which yield in luxuriance and colour to none in England. Then, during summer, a sky for weeks together unclouded, with a temperature often oppressive, and in winter, a clear and constant cold, unfelt in any part of Britain, and sometimes approaching that of Russia. We here find, also, a city of at least forty thousand inhabitants,† with wide and rectangularly built streets (unfortunately, however, with a pavement no way superior to that of Kirkwall, and far inferior to that of Lerwick); a seat of government, with a royal palace, which, if its architecture is no ornament to the town, is of a size quite equal to the occasion; the Storthing hall, or house of Commons; a great and flourishing university, with excellent museums, library, and astronomical and magnetical observatories attached to it, and reckoning amongst its professors many of the highest merit, and several of a European repu-

* Apples, cherries, and even pears and apricots, ripen in the open air.

† The population was 33,000 in 1835, having been only 10,000 in 1815, a sudden increase due, no doubt, to political circumstances. I have supposed 40,000 to be a moderate estimate of its present amount.

tation; a respectable port and mercantile quarter, with extensive wooden warehouses built into the sea, according to the Norwegian custom; and in whatever direction we choose to walk from the town, we meet with cultivation or with shelter, with woodland scenery, or with green fields or country seats agreeably distributed upon nearly every high ground overlooking the fiord.

These peculiarities and these contrasts are due to conditions of climate and situation now tolerably well understood, yet far too striking not to create a pleasing surprise, even when the causes are known, and the results anticipated. The existence of such intelligent, wealthy, and polished societies as characterize the Norwegian cities of Christiania and Bergen on the 60th degree, and Throndhjem, nearly on the 64th, indicate a concurrence of circumstances favourable to civilization, which are not to be found at the same distance from the equator in any part of the globe. They are striking consequences of those laws of physical geography which produce many of the phenomena purely natural, which it is our object in this work to illustrate and explain.

After a short stay in the pleasant and intellectual society which Christiania affords, I proceeded, along with two English friends with whom I crossed the North Sea, by the usual route to Throndhjem, and also by the usual Norwegian conveyance, the *Kariole*, or as it is usually written by Englishmen, carriole. This is a sort of gig with room for only a single passenger, and devoid (usually) of springs. Their place is in some measure supplied by long elastic wooden shafts, supported behind on the axle-tree, and in front on a small saddle, the animal being harnessed exceedingly far forward, whilst the seat is also

advanced considerably, so as to give the traveller the benefit of the elasticity of the shafts. The horse has therefore a considerable portion of the direct weight of his burden pressing on his shoulders; for the small board behind, on which the luggage is strapped, is so nearly above the axle as to afford a very trifling counterpoise. All this is sufficiently contrary to our ideas, and the mode of attachment of the shafts to the harness appears equally faulty. All that can be said is, that the Norwegian ponies know what they have to do, and usually do their work well. The traveller stretches out his feet right in front of him, into a narrow trough prepared to receive them, beyond which is a splash board, to which is attached a leather apron, and he is so closely fitted into his vehicle all round, that the rain does not easily insinuate itself. In addition to top-coats, an umbrella may very well be used in driving, except when the wind is high or the horse vicious, though I am aware that that useful implement is often ridiculed by travellers. The horses are changed at every stage (of which the usual length is from six to twelve English miles), being furnished by the neighbouring peasants, who in rotation are bound to supply them. The owner or his boy accompanies the carriage, and usually sits on the top of the traveller's bag or portmanteau. To secure horses, it is necessary to send on a *Forbud-Seddel*, or schedule, ordering them to be in readiness on a given day and hour. If the traveller disappoints the postmaster, either by delay or non-appearance, he is liable to a fine. It is most economical to send these schedules a day or two before, by the letter post, to the different stations on the line of journey; but those who are making their first essay in this novel mode of travelling, do wisely not to commit themselves so far before hand. In general

the traveller may confidently expect civility and honesty both from the postmasters and the peasants, even though his knowledge of the language (Danish) be trifling. If he calculate the sums which he is due correctly beforehand, and be provided with sufficient change, there is no risk of detention.

The journey from Christiania to Throndhjem we accomplished in eight days, on two of which we partly rested, and one day was spent on the heights of the Dovre-field. The distance is estimated at about 330 English miles, but of this about eighty miles are performed by steamer on the lakes of Miösen and Losna. In no part of the road can the scenery be characterized as reaching the pitch of alpine sublimity; it is, however, tolerably characteristic of the Norwegian style, and in some places, may be called grand. Such are the entrance of Gulbrandsdal, between Lillehammer and Moshuus, the pass between Laurgaard and Haugen, and the descent of the Driva from Kongsvold to Drivstuen. These are all scenes in valleys or ravines, and as such are probably equal to any to be found in Great Britain. But we have more striking mountain scenes in Scotland, than perhaps any which this great highway, across one of the most massive mountain chains in Norway, presents. But this is, in some degree, characteristic of the country. The ravine and coast scenery of Norway are the most picturesque; few of its mountain ranges, at least south of the arctic circle, present noble outlines. Whilst in other countries the plains and valleys constitute the greater part of the area, we have here masses of a considerable height, in which the valleys and other excavations form the exception, and are in very many cases either troughs or ravines. The eye longs to look out

beyond, and to see the commanding summits which in other mountainous lands form the boundaries of the valleys, and which from time to time are usually exposed to view. But in Norway we may travel for days together in hollows which command no distant prospects whatever, and may be in the immediate neighbourhood of the greatest mountains in the country, without being aware of it. All this is well illustrated on the road from Christiania to Throndhjem, which has been so often described by travellers, as to require no farther notice here, except in so far as it illustrates the physical geography of the great northern peninsula.

During the greater part of the first day's journey from Christiania to the banks of the Miösen Lake, we traverse table lands at the very moderate elevation of 600 or 700 feet,* which have little either of beauty or fertility to recommend them, and which will be traversed ere long by a railway, the first in Norway, an innovation scarcely to be regretted, since the country is not only uninteresting, but the road execrable. The Miösen Lake itself fills one of those valley-expansions which are so common in Scandinavia, and is here the receptacle of the noble river Lougen which has already run a course of about 130 miles before it falls into the Miösen at Lillehammer. The scenery of the lake has the common fault of want of a background. The banks are of tolerably even height, and therefore monotonous. We miss those lateral *vistas* through which the eye may wander and the fancy speculate, until the receding ranges of mountains are confounded with the clouds. In other respects it may compare with several of the Swiss lakes, and the distribution of wood and pasture, with ranges

* Trögstad, 590 Rhenish feet.

of log-houses amidst the openings in the forests of fir, at a height of several hundred feet above the bank, has very much of the Swiss character. At the head of the lake is the thriving village of Lillehammer, where we disembarked and resumed our carrioles, commencing the long traverse of the valley of Gulbrandsdal. The lake of Losna, some 20 miles farther up the course of the Lougen, has a decidedly more alpine character than the Miösen. The banks are steeper, and adorned with hanging woods of birch and pine; habitations are rarer, and so narrow is it in most places, that the character of lake is repeatedly lost in that of river; and, notwithstanding its width, which, though small for a lake, is great for a river, the current is sufficiently strong to propel in most places the logs of timber felled in the upper valley, and which are slowly urged onwards by the almost insensible advance of this vast body of water. Here a small steamer again assists the traveller over a certain part of his route.

From Elstad, where we leave the lake, the valley of Gulbrandsdal extends continuously to the foot of the Dovre-field, and the ascent is very gradual, with the exception of the picturesque ravine near Laurgaard already referred to. But we are in truth in the mountainous region a little earlier. The ravine of Kringelen, just beyond the post station of Solhjem, and the place of Sinclair's surprise and massacre,* is marked by the union of an important tributary

* Colonel Sinclair commanded, in 1612, a body of troops raised in Scotland for the service of Sweden, under Gustavus Adolphus. To avoid being cut off by the Danes, who then occupied the greater part of Norway, Sinclair landed his troops, 900 strong, at Romsdal, and marched across the country. But the peasantry, warned of their approach, laid an ambush in the defile of Kringelen, similar to that recorded in the Tyrolese war of independence. The

on the right bank of the Lougen, the Otta Elv, which forms higher up a lake of great length called the Otta Vand, and one origin of which may be traced to within not many miles of the waters of the Western Ocean in the Lyster-fiord, and to the very highest mountain summits in Norway, the Ymes-field. The other great branch which our road pursues rises a little to the west of Sneehättan, on the Dovrefield, so that this important river drains by far the greater part of the greatest mountain basin in the peninsula; and as this basin is inclosed for a wide extent by mountains covered with perpetual snow, the Lougen naturally attains its highest level, like the Rhine or the Aar, in the middle of summer, when the melting of the snows is most active.

At the Church of Sel, or Sæl, which is just beyond the partition of the streams just mentioned, we are only 1170 feet above the sea, the ascent having been so far gradual; but the rapid ascent to Haugen brings us into a valley of a different character, purely pastoral, and resembling alpine valleys from 5000 to 6000 feet above the sea. Yet at the Church of Dovre (a singular and ugly structure, covered, roof and sides, with enormous flags of clay-slate) the river Lougen has a height of only 1500 feet, being 500 feet higher than at the bridge of Laurgaard; but the road at the intermediate pass of Rustenberg has attained the height of 1800 feet, and on the 2d of July snow-patches appeared on the shaded slopes to the left in almost startling proximity.

invading army were overwhelmed with an artificial avalanche from the heights, of rocks and missiles, and are said to have been cut off nearly to a man. We saw a stone marking the spot where Sinclair fell, and some not uninteresting relicts of the fight in a neighbouring cottage.

From Tofte, which is the next stage, some snow-capped summits may be seen in different directions, but none of any great magnitude or boldness of form. But in reality we are now surrounded by the lofty heights of the Dovre and adjacent chains, having left far behind us on the right the lofty but isolated group of the Rundane mountains, and on the left, though at a greater distance, the great snow-covered hills of Lom, though both are quite unperceived from the deep valley of the Lougen. The grandeur of the defile of Rustenberg, and the alpine character of the vale of Tofte (or Lessoe, as Gulbrandsdal is now called), with the glimpses of perpetual snow in both directions of the valley, infused for the first time something of an alpine spirit into our journey. The cultivation of corn—rye, oats, and barley—which disappear usually in the order I have just named them, and which may all be found in the lower part of Gulbrandsdal, had given place to exclusive hay crops, just as we see in the upland valleys of Switzerland.

With the exception of Lillehammer on the Miösen Lake, nothing like a village has been passed since we left Christiania; yet Gulbrandsdal is one of the most populous and fertile districts in Norway. It is a singular peculiarity of the country that villages are almost unknown, at least if we except the west coast, where there is a slightly greater tendency to concentration. When we look at Munch's excellent map, and see it crowded with names, we fancy that the country must be populous. But these spots so named are single houses, or at most two or three nearly connected, where as many families reside, which constitute a *gaard* (pronounced *gore*), usually occupied by a peasant-proprietor who (at least in the remoter districts) takes his name from the *gaard* which he possesses or where he resides,

as is common in the Scottish Highlands.* This dissemination of houses, this absence of villages—an index in some degree of the peculiar political condition of the country and the universality of landownership—is one of the most singular features of Norway. It gives at first a dreary interminable aspect to a journey, like that of a book unrelieved by the customary subdivision into chapters, where we are at least invited to halt, though we are at liberty to proceed. Another feature is the paucity of churches in most places, although again in others they seem crowded in needless profusion; the last is a very rare exception, but I recollect on the way from Bergen to Christiania passing *four* in a single stage. I think we did not see as many in the whole journey by land from the Miösen to the Dovre-field. They are almost invariably of the homeliest description, trees seem rarely to be purposely planted near them, and what is stranger still, they are usually quite isolated, or with only the *Praestengaard* or parsonage in the neighbourhood. In almost every other European country, the habitations, as a matter of course, cluster round the parish church. The absence of this natural and pleasing combination is another peculiarity of social manners in Norway, and in striking contrast with Switzerland, where the village and the village spire offer a continual landmark to the traveller in all the more populous valleys.

The station-house at Tofte is an excellent specimen of

* *Gaard* signifies a fence, an enclosure, a country seat. Humboldt (in a note to his Kosmos) incidentally mentions how extensively this word and its analogues are to be found in several tongues; the Gothic *gairdan* to gird, English *garden*, German *garten*, and Sclavonian *grad*. In Persian *gerd* means a circle and also a castle.

the best class of Norwegian country inns. It resembles closely the houses of entertainment kept by the Swiss peasants of a superior class at a distance from the great roads. Here, as there, there is also something of aristocratic pretension on the part of the peasant-proprietors. As we find in the Valais ancestral portraits of six or eight generations, so in the inn at Tofte we saw several handsome pieces of furniture and other *heirlooms*, and we learned that our host claims a descent from Harald Harfager, one of the ancient petty kings of Norway. As an instance of the simplicity of communication, I may mention that at this principal inn, on the most travelled road in Norway, I found it impossible to post a letter for Christiania, although a well-appointed and rapid post-conveyance passes each way twice a week. I was told that at the next station, Lie, it might be done; but I was there again at fault, and had to send a special messenger to some third station with my letter, at double or three times the expense of the whole postage to Christiania!

At Tofte we slept on the third night of our journey, the two first having been passed respectively in the steamboats on the lakes of Miösen and Losna. We spent the morning at Tofte, our carrioles already requiring some repairs, and the day's journey to Jerkind being short. From Lie, the ascent of the Dovre-field begins in good earnest, but we had so gradually attained a height of above 2000 feet, that the ascent disappointed me. The valley of Lessoe (which we here quit) continues a tolerably level course towards the north-west, and is traversed by the high road to Molde, through Romsdal. The Lessoe Vand, a lake at the summit level, is only 2000 feet above the sea,

and is remarkable in this respect, that a stream issues from each end of it, the one communicating with the waters of Gulbrandsdal, the other with the North Sea, at Molde. And such seems also to be the case with the Otta Elv, the other great branch of the Lougen already referred to, which receives water from the Breiddals Vand, from which a stream likewise runs into the Stor-fiord, on the west coast. On the whole, the Lessoedal, above Tofte, is the most remarkable indentation in a mountain range to be observed anywhere in Norway. It affords a direct and easy communication from the heart of the peninsula to the North Sea, eluding, as it were, the lofty mountains which it divides—surrounded in all directions with perpetual snows, yet not itself rising to the upper limit of the pine. At Lie we parted with regret with a young Norwegian on his way to Molde, through Romsdal, who spoke English, and whom we met on board the steamer. With the customary politeness of his countrymen, he assisted us in making out our *forbud* papers thus far, and in making all arrangements on the journey. On board the same steamer I was addressed by a gentleman from the west of Norway, entirely unknown to me, who, after some conversation, invited me to visit him there, and gave me useful local information. I afterwards experienced the full benefit of his hospitality.

As we ascended the Dovre-field to Fogstuen, we were interested in observing the well-defined limits of growth, first of the spruce, then of the pine, and finally of the birch. The hills here are very generally wooded up to the height where these several trees can grow. At the limit of the Scotch fir, the aneroid barometer belonging to one of my companions stood at 27.11—the temperature of the air was at 53°. This may correspond to

about 2870 English feet above the sea.* I estimated that the common birch reached a height 400 feet greater.† We touched granite *in situ* before reaching Fogstuen, which, however, occupies but a limited space. The view of the Dovre-field or *plateau* is dreary enough from hence, even in fine weather; in winter, or during storms, it must be wild indeed. It is a table-land of an average height of 3000 feet or rather more above the sea, from which rise mountains, attaining, in the case of Sneehättan, and possibly one or two others, an elevation of above 7000 feet; but the greater part are far inferior to this, and of such rounded forms, and spread over such wide surfaces, as to produce less picturesque effect than any mountain chain of the same magnitude with which I am acquainted. Even Sneehättan is not a commanding object, and the table-land rises so gradually to the level of its immediate base, that the eye is singularly deceived as to its real distance, and consequently its real elevation, both of which are greatly underrated. The facility with which the Dovre-field is gained would alone diminish its effect if it had any; but being entirely devoid of the character of a *barrier*, and consisting of undulating surfaces of hundreds of miles in extent, and rarely attaining the snow line, it has a character of mediocrity which must disappoint almost every traveller.

The drive from Fogstuen (a single farm-house) to Jerkind is nearly level, over the table-land of the Dovre-field. It resembles the moorland scenery of some extensive

* By comparison with observations at Jerkind, of which the height is estimated at 3100 English feet.

† The mean of Naumann's and Hisinger's measures gives 2870 Rhenish feet (= 2960 English) for the pine, and 3350 for the birch.

wastes in the Highlands of Scotland. The inequalities of the surface are filled with swamps and wild tarns; the drier spots are interspersed with stunted brushwood. One lake of moderate size is skirted by the road for a considerable distance: it has almost a picturesque character, from an occasional cliff of overhanging rock, which is here hornblendic slate or gneiss, with occasional tangled birch. The level grounds are nearly covered by rocky debris, but I did not observe angular blocks of any unusual size: tameness of outline is the prevailing characteristic. After passing two lakes, whose waters run eastwards into the Glommen—the greatest river in Norway—the road rather descends for a considerable distance. At length the station of Jerkind comes in sight, towards which the road rises rapidly. Here better pasture appears, and the surface assumes a greener and less inhospitable appearance. The station is, however, in a very exposed position on the last ascent of the Dovre-field, and at a height not inferior to that of Fogstuen, or at about 3100 English feet above the sea. It is a substantial farm-house, with appendages, and has long been possessed by persons of substance. In order to accommodate travellers who very frequently pass the night here, a separate building has been erected on the opposite side of the road for their occupancy. There are not, however, more than five beds, and we found the management of the house less good than we expected from the high character it has usually borne. I am afraid something is to be attributed here, as elsewhere, to the recent influx of English visitors who usually pass the night at Jerkind, and sometimes remain for a time in pursuit of game. We preferred in this respect some of the inns on the road less known, and offering homelier accommodation.

Nor can I let this opportunity pass of expressing strongly a hope, felt by all I believe who have travelled in Norway, that our countrymen will take a lesson from the effects visible on the continental thoroughfares, of too frequent instances of English selfishness, arrogance, and belief in the unlimited powers of gold; and that they will display in this comparatively new country a degree of considerate moderation in their expectations and their actions, which may preserve to Great Britain the *prestige* of attachment and regard commonly found amongst all ranks of this free, intelligent, and fine-hearted people.

We prepared for the ascent of Sneehättan on the following day, which was the 4th July.

CHAPTER II.

SNEEHÆTTAN—DOVRE-FIELD TO THRONDHJEM (DRONTHEIM).

ROUTE FROM JERKIND TO SNEEHÆTTAN—THE ASCENT—HEIGHT OF SNEEHÆTTAN—THE VIEW FROM THE TOP—RETURN TO JERKIND—KONGSVOLD—THE VAARSTIGE—ACTION OF GLACIERS—MAINTENANCE OF THE ROADS IN NORWAY—TRAVELLING IN SPRING—DRIVSTUEN—AAMOSELV—GEOLOGY OF THE DOVRE-FIELD ACCORDING TO NAUMANN—THE RIVERS OERKEL AND GUUL—THRONDHJEM.

THE distance of the base of Sneehättan from Jerkind is reckoned at two Norwegian, or 14 English miles. The country traversed is characteristic of the Norwegian *fields*—nearly trackless; the traveller, or rather his sagacious pony, must explore his way through swamp and heather—amongst holes and accumulations of loose stones, most dangerous for a horse—across rapid streams, nearly ice-cold; and, worst of all, over numerous and wide patches of still unmelted snow, treacherous even for the foot of man, and in which our ponies floundered up to the saddles. There was little of picturesque interest to redeem the toil of this scramble of four hours' duration. Sneehättan itself was the only object at all remarkable in outline, and it rose before us in a manner so gradual, that it seemed as if we should never reach it.

The changing aspect of the scanty vegetation of this

wilderness was the chief evidence that we were really ascending. Soon after leaving Jerkind, the common or white birch is left behind; then willows, more or less stunted, succeed, with juniper. Both these plants cease together, and the creeping dwarf birch, a very pretty spreading undergrowth, scarcely six inches high, with reindeer moss, are nearly the only generally spread plants; but we saw the *ranunculus glacialis* in flower. At length, even these scanty traces of life almost disappeared, and tracks of loose shingle freshly uncovered by snow, and steeped in cold moisture, afforded a slippery and uncertain footing to the weary horses. The beds of snow having become so frequent as nearly to cover the plain, we left our horses in charge of a boy, on a space covered with slaty debris, and trickling with melting snow, affording a most comfortless bivouac. The level here appeared by the aneroid barometer to be about 1900 English feet above Jerkind, or almost exactly 5000 above the sea. It gives a correct idea of the flatness of the *field*, that we had only crept up these 1900 feet in the course of a ride probably not overrated at 14 miles.

We proceeded on foot with our elder guide to the ascent of the mountain, which rises with sudden steepness from near the point where we left our horses. At this still early period of summer it was covered with snow, except where the winds had drifted it from the blocks of mica slate which strew its slopes. It was now noon, and the heat of the sun (though not very great), had softened the snow, through which we struggled with great fatigue—often sinking quite to the waist—until we gained the firmer slopes. The ascent was both disagreeable and dangerous, the foot sinking at every step amongst the interstices of the blocks already mentioned, threatening dislocation or broken bones. After

a tedious and fatiguing scramble, we gained harder footing as we approached the summit, where the walking was comparatively easy; but the wind, from which we had been sheltered by the mountain during the ascent, blew chilly in our faces, and rendered it impossible to remain for any time exposed to it when we reached the top, which was about three o'clock. We then saw clearly that the form of the mountain is a ridge running nearly east and west, precipitously broken towards the south, and sloping steeply in other directions. The chasm on the south has been compared to a crater—the mountain ridge bending partly round it like the cliffs of Monte Somma, with which in steepness it may compare; whilst the elevation is much greater. It has been stated that a lake exists in the hollow, but at this time it was no doubt frozen, and concealed by beds of snow; and, according to M. Durocher,* a small glacier is lodged under the cliffs of Sneehättan. This also was of course concealed by the abundance of the remaining snow. The ridge itself is wildly serrated, and, like the entire mountain, is composed of a rather friable mica slate. The part on which we stood was a cone of pure snow, cleft vertically on the side of the precipice; one point a little to the westward appeared to be a few feet higher, and to this one of our party proceeded, by making a considerable circuit, whilst I in vain attempted to inflame a spirit of wine furnace for taking the temperature of boiling water, for the wind blew rather strongly from the west, and felt bitterly cold—the temperature being 34°. The aneroid barometer stood at 22.53 inches. The cold compelled us soon to quit our position, but not until

* Annales des Mines, 3d ser. tom. xii.

we had carefully surveyed the panorama of mountains, which for the most part were fortunately still clear, although the gathering clouds towards the north betokened a change of weather, which soon followed.

Sneehättan, for a very long period considered to be the highest mountain in Norway, attains, according to the best observations, a height of about 7400 Rhenish or 7620 English feet above the sea.* Our observations give a height of 2600 English feet above the station at the foot, or 4500 above Jerkind, and 7600 above the sea; a remarkable coincidence, considering the somewhat unfavourable circumstances in which the observations were made, and that the thermometric correction of the instrument itself is not taken into account.† It was first ascended in the last years of the 18th century, by Professor Esmark, who estimated its height about 500 feet too great. Not many years after, it was ascended by Sir Thomas Acland. Though exceeded by a few hundred feet by the Store Galdhöpiggen, belonging to the Ymes-field, in the direction of the Sogne-fiord, the difference is not sufficient to give a commanding appearance to that range. Some of the forms are however picturesque, especially the striking summits of the Ruhdane

* Gæa Norvegica, p. 192.

† The aneroid barometer in question, which belonged to one of my companions, had had its scale scrupulously verified in London. These instruments may, with ordinary care, be transported *anywhere*, even in carrioles or carts, as they are easily suspended from the shoulder. As there was one instrument in company, I had sent mine by sea to Bergen for fear of accidents. It is by no means impossible, however, to transport instruments even of some delicacy in a carriole, with due precaution, especially in driving down hill. The safest part of the carriage is, of course, the foot or splash board. The aneroid barometer is unquestionably the most valuable aid of its kind to the promotion of Physical Geography invented for many years.

or Rondene mountains, to the south-east, which approach 7000 feet, and the extensive snow-fields, to the south, connected with the mountains of Lom and the Ymes-field. I believe that I saw distinctly the Store Galdhöpiggen, and the Glittertind, although the great distance, and the number of other ranges not much its inferior in height, diminish greatly the picturesque effect. Of course from this elevation the plateau of the Dovre-field is seen in all its vastness and desolation. As we are unable to see to the bottom of any of the valleys, the eye can only range from its level to that of the summits beyond. This again contributes to lessen the apparent height of the mountains. The ridge to which Sneehättan belongs runs east and west for a considerable extent. It is well seen from Fogstuen as has been stated, and the impression I then had, that the mountain immediately to the westward called Skreahög, is little inferior in height to Sneehättan, is confirmed by what I find in Naumann's Journal—that geologist having partially explored the almost untrodden wilderness in that direction, where the level of the table-land of Dovre is higher than in any other part, and several summits belonging to the same chain are, in the estimation of that writer, not more than 500 or 600 feet lower than Sneehättan.*

Our descent, though much less fatiguing than the ascent, required the greatest precaution to avoid serious injury to our legs amongst the stones and snow. We all reached the horses in safety, and returned by nearly the same track. The principal torrent to be crossed, which is in fact no other than the source of the river Driva (which we were to follow for a long way on our next day's journey),

* Beiträge zur Kenntniss Norwegens, ii. 278.

was deeper than in the morning. To cross these streams without horses would be a very serious undertaking. Near this ford was almost the only spot presenting any verdure or shelter on the whole route. It was a little plain close by the stream, where it issued through a narrow defile of rock, and skirted a rising ground, which broke the sweep of the westerly wind. Here was a sort of meadow; green, and also slightly protected by some stunted willows. On this meadow a few horses grazed, and, as we understood, the summer abode of a hunter who spends his time amongst the wildest recesses of the Dovre-field was at no great distance. But wet, cold, and weary as we were, we felt little disposed to seek him. That such a spot should be worthy of mention may give an idea of the unvarying sterility of the *field*.

I looked with attention for any traces of the action of glaciers, either by wearing and polishing the rocks where they came into view, or in the deposition of moraines, but I saw nothing very decisive of either kind. The friable and slaty rock is not favourable to the preservation of impressions of the former class, which are rare and ill-defined; nor are the mounds of stones, which are abundant enough, sufficiently characteristic to deserve the appellation of moraines. They are indeed sometimes disposed in elongated flat-topped ridges; but this is due, if I mistake not, to the eroding action of torrents which have gradually undermined them, leaving abrupt *talus*, which at first sight resemble moraines, but which in their present form it is difficult or impossible to identify. The surprise which I at first felt at observing no more distinct traces of ancient glaciers diminished afterwards, upon reflection that had such glaciers existed, they must

have covered contemporaneously the whole of the vast extent of the Dovre-field;—that if they could have moved over such inconsiderable slopes, the motion must have been nearly insensible;—that the traces of such ancient ice formations (if they existed), must be sought in the deep valleys or outlets of the field, where true glaciers must have protruded themselves from under the snow-line, with a considerable declivity;—and finally, that any change of climate tending to contract the limits of permanent snow and ice, must have acted with simultaneous energy over the greater part of the vast *plateau*, which maintains a nearly uniform level of between 3000 and 4000 feet, which, in the colder conditions of climate assumed, must have been entirely *above* the snow-line, and after even a moderate relaxation of the rigour of the climate, entirely *below* it. Supposing such a change to have occurred at all suddenly, the overwhelming torrents of water to which it must have given rise would more than suffice to annihilate any definite constructions of moraines. At all events, I repeat, that the absence of great travelled blocks, angular or otherwise, on these extensive uplands, is an important physical peculiarity. The blocks on Sneehättan do not come under this description, being, though detached, evidently *in situ*. These have been referred to as singular and anomalous. They frequently accompany, however, the spontaneous decomposition of rocks of the granitic family, of which the Cairngorm hills in Aberdeenshire afford a good example, the blocks on Ben Macdhui being much more striking than those of Sneehättan.

I may here add, that the ascent of this mountain (now no longer the first of its class), appeared to me to be scarcely worth the weariness and monotony of the excursion: and

to persons not especially interested in physical geography it is still less to be recommended. The presence of bad weather could alone have made it more disagreeable. The snow was in the worst possible state. I suppose that towards the end of summer, when it has retired to its farthest limits, or in a calm morning after a sharp frost, the ascent might be better worth undertaking.

On our return to Jerkind, we supped on reindeer soup, which we found excellent. The following morning we crossed the summit level of the pass, which is about 4100 English feet, but has not been very accurately determined. It is, I believe, the highest carriage road in the north of Europe. We had reason to congratulate ourselves upon having seen so well from Sneehättan the panorama of the greatest mountain masses of Scandinavia, for the hills were covered with mist. We soon after joined the Driva in an upland valley of the usual sterile character of the *field;* but the scenery improved in interest as we descended the defile through which the torrent dashes, and reached Kongsvold, where a tolerable inn and its dependencies are placed—a welcome shelter to a traveller on such a road. The stage from Kongsvold to Drivstuen has been so often described, both for its picturesque grandeur and on account of the excessive acclivity of the road, that such details seem unnecessary. I must, however, state that such scooping and polishing of the rocks as is usually ascribed to the action of glaciers, occurs near the highest point of the road on this stage, a place called Vaarstige, and which is so remarkable that no traveller having passed it is likely to forget it. For here the valley—which, from the entrance of the defile specified above, had been narrow and rugged enough, offering only a little enlargement at Kongs-

vold—suddenly contracts to such a degree as nearly to bar the passage; the torrent tumbles headlong down a rocky chasm, and a great elbow of rock presents a nearly inaccessible face towards the stream, of immense height, over which the road is carried, so that in the course of a few furlongs we reascend until we are considerably above the common level of the Dovre-field at Jerkind, which we quitted some hours before.*

The height of the road must be about nine hundred English feet above the torrent. Now precisely here we find the (so called) glacier markings perfectly developed, following the direction of the ravine, and similar to those seen in the rocky contraction of alpine valleys; and, indeed, under similar circumstances in every country in Europe. The explanation of their appearance here is sufficiently obvious on the glacier theory. The mass of ice which must have descended this valley, if the Dovre-field was ever included within the snow-line, must have formed one principal outlet of the icy superfluity of that prodigious reservoir. And as it must have accumulated behind the rocky elbow of the Vaarstige in the same manner that a great and sudden flood of water would do now, until the superincumbent pressure of thawing ice was sufficient to force it past so tremendous an obstacle, it is self-evident that the rocky obstacle must have resisted that pressure, and borne the traces of it in that peculiar erosion which those moving semi-rigid masses of ice are known to impress (through the medium of the fragments and particles of pulverized rock which they invariably carry on their lower surface) upon the barriers which oppose their progress. Thus far the appearances

* Vaarstige, 3150 Rh. feet; Kongsvold, 2846; Jerkind, 2907; Drivstuen, 2157.—*Naumann.*

may be accurately explained. Perhaps it may be matter for surprise that they are not more universal and obvious even in this valley, where (by analogy) it is almost impossible to doubt that glaciers have once descended. Some general reasons might be assigned, but I will only mention one here; and this is the very remarkable rapidity of disintegration of the most solid rocks perpetually going on in Norway, which has evidently the tendency to obliterate all superficial impressions. Prodigious falls of blocks detached from mountain precipices occur every year, and by the freshness of their colour are palpable to the passer-by. Their frequency is very striking compared with the Swiss valleys. It is attributable, I suppose, partly to the severity of congelation in winter, but especially to the great quantity of snow and rain which falls over a great part of the mountainous regions of Norway. This occurrence, known in Norway under the name of *Bergrap*, is correctly described and accounted for by Pontoppidan, who cites some very striking instances of devastation occasioned by it in the diocese of Bergen.*

Having mentioned the extreme rapidity of the ascent and descent on the pass of the Vaarstige, which is remarked by all travellers, I may observe that this regardlessness of *gradients* (as it is the fashion now to call them) is common all over Norway, and in description gives rise to the idea that the roads are in worse condition and more dangerous for travelling than is really the case. In such situations as the one now described, they are almost inevitable, unless a roadway is to be excavated by sheer force of blasting out of the solid rock, and such a road is now surveyed and in

* Natural History of Norway, i. 60.

the fair way of execution. In a great many other cases the steep hills might most easily be avoided, and arise from the natural process of road-making in a poor country, which is to improve footpaths into bridle-roads, and these into post-roads. The expense of any alteration of a line is a very heavy one compared to its maintenance, and is defrayed (I believe) by a special vote of the Storthing, whilst the latter (the maintenance) is performed by the compulsory labours of the adjacent proprietors—every road in Norway having its length subdivided into countless small portions, sometimes only a few yards in extent, and denoted by posts supporting small painted boards which indicate the name of the property liable for the maintenance of the highway, and the number of ells (*alen*) which corresponds to it. Under such circumstances, it is only surprising that the roads are so generally good and uniformly kept. Exceptions of course occur, arising chiefly either from heavy traffic, or from dearth of suitable material. Natural gravel abounds in most parts of Norway, and is usually employed to mend the roads; but in clayey or sandy soils the state of the highways is bad even at the best season, and after bad weather it is of course still worse. "Macadamising" is unknown. The sort of attempts towards it, at either end of this great highway—that is to say, within a few English miles of the modern and ancient capitals of Norway, Christiania and Throndhjem—make the over-jolted traveller wish that it had never been thought of. As a general rule, however, I repeat that this and other great roads are, on the whole, excellently kept. By degrees the engineering of the highways is being improved. Nowhere, for instance, are natural difficulties better overcome than on some parts of the great road from Christiania to Bergen across the Fille-

field. The climate, as well as the uneven surface of the entire country, presents great difficulties in the perfect maintenance of roads. The disruptive power of frost in winter, and the impetuosity of the torrents and avalanches in spring, are formidable agents of degradation and decay.

No language can adequately paint the discomforts of a journey in Norway, when the melting of the snow has fairly commenced. Von Buch, who travelled the very road we are describing in the months of April and May, gives us some idea of it in his admirable journal.* The roads have not snow enough for sledges, but too much for carrioles; they are in fact snow pits too narrow for the wheels of a carriage, and retaining streams or pools of ice-cold water. In some places where the snow is deeper, yet incapable of bearing the weight of a horse, he plunges to the girths or deeper, and stands trembling and helpless until assisted to extricate himself; and now the traveller, driven to his own resources, advances on foot, plunging first one leg through, then the other, or both at once, finds himself astride upon the snow with both feet dangling, immersed in running water beneath. The pass of the valley of the Driva, which has led us into this digression, is not only disagreeable but most dangerous in spring-time. In summer, as we have seen, a safe but most fatiguing road must be climbed high over the out-jutting rocks. In winter the way is easier, for then the sledge may be securely driven on the snow over the course of the torrent down the hollow of the valley all the way; but in spring the former course is not open, and the footing on the latter is not secure. The buried waters are aroused from their winter's

* See Von Buch's Travels (in German) i. 149, 193.



James D. Forbes, del. C. Haghe, lith.

Day & Son, lith.rs to The Queen.

VAARSTIGE DOVRE-FIELD.

repose; the crust of ice and snow becomes thin and unsafe; the horse plunges into, and must be withdrawn from, a thousand perilous chasms before this most formidable passage is accomplished. No one, then, it may be easily understood, travels in Norway in the end of April and beginning of May, unless compelled by circumstances to do so.

No such difficulties attended our proceedings. I walked forward on foot, leaving the carriole to the care of the guide, and enjoyed the grandeur of the scenery—the best we had seen in Norway, and comparable to the finest in the Scottish Highlands, though hardly deserving the name of alpine. The outlines are noble, though the scale is inferior to that of Swiss scenery. A few of the summits rise nearly into peaks, whilst the ravine is bounded, as we have already said, by lofty and majestic precipices, fringed here and there with birchwood, and interspersed by cascades. The form of the mountain opposite to the Vaarstige is particularly fine. In Plate I. a view of the Vaarstige is given, looking back to it from the valley beneath. The highest part of the carriage-way is seen on the left hand of the sketch, near the upper part, where it passes under a cliff strongly marked by glacial action. The descent towards Drivstuen, if not quite so rapid as the ascent from the side of Kongsvold, is longer, and more diversified; the road rises and falls many times amongst the half-rounded summits of abraded rock. New views of the ravine and of the lower valley of the Driva are obtained, and the birchwood becomes at each stage of the descent more and more beautiful. We are still far above the limit of the pine. At length we regain the level of the stream; the valley opens for a time; it also acquires a habit-

able and cheerful aspect; and the little hamlet of Drivstuen is agreeably situated on a sunny spot amidst productive meadows, though overhung on both sides with lofty and precipitous mountains. The space in front of the inn, and the inn itself, were crowded with peasants—the occasion being, as we understood, letting the contracts for the improvement of the line of road which we had just traversed. We had here consequently a good opportunity of observing the characteristics of the male inhabitants of this district of Norway. The opinion of a passing traveller ignorant of the language, is perhaps hardly worth stating; but having some faith in physiognomy, I will venture to record my impression at the time, that I had never, in any country, seen so fine a peasantry, in point both of general appearance and of expression, as on this journey, and more particularly on the north descent of the Dovre. The younger men are tall and muscular, and their deportment unites manliness with gentleness in a remarkable degree. As the hair is worn long at all ages, the appearance of the aged men is venerable and occasionally highly striking. The costume is extremely becoming, being of pale brown home-manufactured woollen cloth, slightly embroidered in green, with a belt, curiously jointed, of leather and brass, from which hangs a knife (also made in the rural districts) with a carved handle, which is used in eating. A hanging red woollen cap completes the dress. Some travellers declaim against the slowness and stupidity of the Norwegians. Slow they may be as regards the deliberateness of their actions, but, so far as the experience of this journey extends, I should describe them as, in general, more than commonly intelligent and courteous.

Drivstuen is the last of the Fieldstuer or houses

of refuge on this formidable pass—formidable I mean in winter or in bad weather, by reason of the great width of its table-land, and the absolute want of natural shelter. These stations are said to have been founded by King Egstein in 1120,* and are four in number, Fogstuen, Jerkind, Kongsvold, and Drivstuen.

Shortly below Drivstuen the Scotch fir makes its appearance, and on the same stage a very remarkable red porphyritic gneiss may be seen *in situ*, and also in immense blocks, which appear to have been discharged from the valley of the Aamoselv, a river which unites with the Driva some miles below Drivstuen, and which takes its rise immediately to the westward of Sneehättan. If the geological sketch of Naumann may be trusted, this remarkable gneiss belongs to a narrow belt which encircles the highest mountain group of the Dovre, from which, as from a centre, this mantel-formed stratification dips outwards, including, where most developed, the following members:—1. and lowest, the friable mica slate of Sneehättan, formerly described; 2. quartz slate; 3. the beautiful porphyritic gneiss now under notice; 4. (on the east side) mica slate. What is the real constitution of the central district included in this remarkable circular formation, does not appear, being left blank in Naumann's map.† It is a problem most worthy of solution; but, so far as I know, little has been done towards it in the last thirty years. I am not unaware that Professor Keilhau‡ does not admit the correctness of Naumann's scheme of the Dovre formations; but if we may judge from the notice to which I refer, he has

* Von Buch, i. 200.

† This central district lies 12 or 15 English miles N.N.W. from Sneehättan. ‡ Gæa Norvegica, p. 404, published in 1850.

not made so extensive personal observations, and has proposed no other hypothesis of arrangement and super-position. In a case like this, a fundamental hypothesis, or construction of the facts, even if in some degree, or mainly false, is better than no hypothesis at all. It is a groundwork for improved knowledge. A mere catalogue of detached data is not such a groundwork until hypothetically collected. The wilderness of the Dovre, northwards and westwards from Sneehättan, is probably an untrodden, yet important field for geological research.

I have made these observations in connection with the porphyritic gneiss of the Drivthal, because it is the most characteristic rock of this district, and its occurrence is so striking as to be mentioned by every geological traveller. Before quitting the topic of geology, I will observe that the granite, already mentioned as making its appearance at Fogstuen, appears to be exterior to and independent of Naumann's great conical elevation of the Dovre-field. It is as it were imbedded in clay slate. Another very similar outbreak occurs about 20 English miles beyond the porphyritic gneiss formation near Drivstuen, on the Throndhjem road. I noticed it between Ovne and Stuen, where it appears under the form of a hornblendic porphyry, which soon, however, passes into a complete granite. Its geological relations are the same as those of the granite of Fogstuen, being associated with clay slate, and it is nearly equidistant from the supposed centre of elevation. It is probable that this eruption of granite is the cause of the sudden turn of the river Driva from a due north to a westerly course, which occasions the main post-road to traverse an elevated ridge, separating the valleys of the Driva and Oerkel, attaining at Stuen a height again little inferior to the

limit of the pine; and the effect of a northerly exposure was here evident by the bleak snow patches remaining even on the 5th of July, at no very great distance beyond that limit. In the course of the evening fresh snow fell, though our elevation above the sea was only about 2300 feet; the country looked sterile, and almost uninhabited,* and we felt as if we had made a sudden advance towards the north. We were now in 62½° of latitude.

The valley of the Oerkelelv, which we reached a stage beyond Stuen, presents an entire change of scenery. Not only the pine, but the spruce fir abounds, or rather the latter soon quite supplants the other, clothing the precipitous banks of a noble river, which is crossed by a bridge near Bjerkager, where we are probably only 800 or 900 feet above the sea, and surrounded by cultivation, though on a scale limited by the narrowness of the valley. But the course of the Oerkel conducts not to Throndhjem, but to the Oerkedals-fiord, another branch of the great Throndhjems-fiord; so that another mountain ridge must be crossed from the Oerkel to the Guul, but this time to a less elevation, and through a more pleasing country—the highest station, Garlid, being pleasingly situated amongst green fields and woods of spruce, the general tone of the scenery vividly recalling that of many parts of Scotland. The descent upon the valley of the Guul, near Soknœs, is extremely pleasing, and the timber fine, with some good cliff scenery, and the river is crossed by a noble bridge in a picturesque situation. From thence to Throndhjem, the country offers little of interest, until, after the exhaustion consequent upon jolting over some miles of what may

* The population of the parish of Opdal 40 years ago was little more than two souls per English square mile.

not unfairly be called the worst road in Europe, the traveller obtains a sudden and delightful prospect of the northern and ancient capital of Norway, charmingly situated on the southern bank of the extensive Throndhjems-fiord, which is completely land-locked; and when we thus unexpectedly look down upon its orderly streets, clean dwellings, tall warehouses projecting into the bay—upon the neat villas amidst trees and fields of the brightest green, country and town churches, and especially upon its once majestic and still venerable cathedral—it is difficult to believe that we are entering one of the most northern capitals, and one of the least visited towns of Europe, which yet possesses evidences of comfort, independence, and self-respect amongst the lower classes, and of intelligence, hospitality, and refinement amongst the upper, which many cities of more pretension might well be proud of.

It does not form part of my plan minutely to describe Throndhjem any more than I have the southern capital of Norway. The shortness of both my visits to Throndhjem would scarcely entitle me to do so. The cathedral, the most interesting feature of the town, has been sufficiently described and deservedly praised by every writer. It is built chiefly of bluish grey chlorite schist, having some resemblance to potstone, which appears to be easily fashioned and to harden on exposure. The tracery of the octagonal stone screen surrounding the altar has a peculiar and pleasing appearance. But such is the effect of demolition and rough casting without, and of whitewash and boarding within, that it is only piecemeal, as it were, that we can perceive the once imposing effect which it must have had. The date of the older part is believed to be 1180, and is in a bold Norman style, of which the transepts and vestry are

the best specimens. The architecture has a general resemblance to St. Magnus's Cathedral at Kirkwall. The latter is incomparably better preserved, but has a more severe and gloomy character. The town of Throndhjem is built almost entirely of wood, but the streets are wide, regular, and well-kept (though the pavement is rough), and the houses are substantial, cheerful, with numerous windows, and scrupulously clean. The roofs are very generally of a red colour. The shops are like other houses, but with a name above the door, and a very moderate supply of goods in the windows. Here, as at Christiania, all persons not only take off the hat but remain uncovered whilst dealing in a shop. Neither in the shops, nor even in the principal inn, did I find a single person speaking any language except Danish. The latitude of Throndhjem is 63° 26′.

The objects of interest in the neighbourhood, including the Leerfoss, a fine waterfall on the river Nid, are also generally known; and I will only mention, that on this excursion my attention was, for the first time in Norway, forcibly arrested by the remarkable series of natural levels or terraces which stretch at intervals for a great way up the course of the river Nid. Such terraces may be traced at intervals along most of the western coast. They are concisely but accurately described by that admirable observer, Leopold von Buch, and in later years particularly, have been examined, and their origin discussed, by MM. Durocher and Bravais, by Mr. Chambers, and many other writers. I offer here no opinion upon the origin of the terraces of the Throndhjems-fiord in particular; but they are amongst the best defined that I have ever seen, and in one instance were not unnaturally mistaken by me for military

outworks, as a field which includes several of them, perfectly grass-grown, is surmounted by a powder magazine.

Though the oak has all but ceased to grow, and few kinds of fruit come to any degree of perfection, the aspect of the country is quite the reverse of bleak; but, on the contrary, cheerful, habitable, and flourishing. Very considerable farming establishments exist in the neighbourhood, and the love of flowers, so characteristic of Norway and its people, is here in the highest perfection. Scarcely a house exists in Throndhjem which has not its windows literally filled with flowering plants, tended by the owners; and so prevalent is this taste, that on all my subsequent journeys in steamboats, we were rarely without packages of flowers in pots, undergoing transport from one port to another. The view over the fiord is varied and picturesque. The hills, though not densely wooded, are by no means bare, and though I believe some distant hills were snow-covered when I saw them, yet probably no elevations of 3000 feet are visible from the shore at Throndhjem. The character once again resembles that of our Scottish Highlands, where the sea so frequently flows into the land between the hills, forming inlets which, in proportion to the size of the country, are as long and narrow as the fiords of Norway. That of Throndhjem extends thirty-five English miles before it reaches the ocean to the westward, and it runs inland to the north-east at least as far.



TORGHATTAN.

CHAPTER III.

NORDLAND.

CHARACTER OF NORTHERN NORWAY—LEAVE THRONDHJEM BY STEAMER—VAERS—TORGHATTAN—ITS CAVERN—ROCHES MOUTONNÉES—YACHTS—THE SEVEN SISTERS—ŒXTIND—ENTER THE ARCTIC CIRCLE—GLACIERS OF FONDAL—BODÖ—SCENERY OF VEST-FIORD AND THE LOFODDEN ISLANDS—ARRIVAL AT TROMSÖ.

THRONDHJEM is a very natural boundary to a traveller's northern tour. In his journey thither he has seen a good deal of the interior of Norway, and unless he mean to extend his travels quite within the Polar Circle, there is little of special interest to entice him forwards, and no definite stopping point is naturally suggested, where he may

gratify his curiosity, and at the same time repose his body and relax his mind in hospitable society—all of which conditions Throndhjem so amply satisfies. Its position too is geographically peculiar. It is at the beginning of the isthmus of the great Scandinavian peninsula, which is here only 250 English miles broad, from Sundsvall on the Bothnian Gulf, to the North Sea at the entrance of the Throndhjems-fiord; and this isthmus continues of nearly uniform breadth until we reach Lulea, near the head of the Gulf of Bothnia, which is also 250 miles from Bodö, on the west coast. The mountains of northern Norway—commonly called the Kjölen range—extend, though not in an unbroken chain, from the neighbourhood of Alten, in latitude 70° (beyond which they rapidly decline), in a S.S.W. direction till we reach the parallel of Throndhjem, where they attain a height of nearly 6000 English feet at Syl-field, on the Swedish frontier. Here the expansion of the peninsula becomes apparent, and the mountainous surfaces spreading in proportion, form those great table-lands, of which the Dovre-field is perhaps the most striking example, still however preserving a general parallelism to the western coast, which is everywhere nearly in contact with considerable hills. The shore of the peninsula north of Throndhjem, which belongs to Norway, is both narrow and mountainous. It contains therefore a small population, and includes only three provinces (*Amter*), North Throndhjem, Nordland, and Finmarken, whilst Southern Norway contains fourteen. It is besides nearly destitute of *longitudinal* valleys, though that of the Namsen approaches a longitudinal direction. Its rivers run comparatively short courses, and their banks offer but few level spots fit for cultivation, and still less accommodation for roads. The interstices of the hills which

run from the main chain to the sea, are occupied by fiords and gulfs; and in numberless cases, these hills, being wholly separated from the mainland, form groups of precipitous, often almost inaccessible islands. When to this is added the rapid approach to a polar climate, where winter swallows up more than three-fourths of the year, it will be understood that in leaving Throndhjem, we enter upon a country secluded by all its physical circumstances from the rest of the world, and possessing many corresponding peculiarities.

As roads almost entirely cease at no great distance from Throndhjem, and communication is kept up by water stages, aided by a few "portages" across narrow necks of land, it was a most serious undertaking, before the institution of steam packets, to traverse the space of above 700 English miles which separates Throndhjem from Hammerfest, the northernmost town not only in Norway but in the world. The few travellers whom curiosity, or the love of science or of sport, impelled to perform this tedious and most fatiguing tour—the Acerbis, the Von Buchs, the Brookes of the earlier part of the century—were in some degree rewarded for their privations, by the more accurate insight they obtained into some of the features of that interesting country, than is to be thought of in these days, when, by the admirable and wise regulations of Government, commodious steamboats establish a convenient and safe communication, once a fortnight, in summer, to every part of the coast. Taking advantage of this arrangement, I left Throndhjem with the companions of my journey from Christiania, on board the steamer "Prinds Gustav," bound for Hammerfest. Having been for a fortnight almost constantly on board this well-appointed and well-

officered vessel, I cannot but record my obligations to Captain Lous of the Norwegian navy, who commands it, who exerted no common assiduity and no common talents, to render the voyage agreeable and instructive to all his passengers, and for his courtesy to myself, I retain feelings of the liveliest gratitude.

The English friends with whom I had travelled from Christiania were on their way to the far north for salmon-fishing. My objects, though different, attracted me in the same direction, and we only parted under the 70th degree of latitude. I had long desired to see the coast scenery of Norway, and to appreciate some of the peculiarities of an arctic country, its snows and its glaciers. The time of year favoured my anxiety to see the sun make the clear circuit of the heavens; for though we had left England on the longest day, the change of the sun's declination is at first so slow, that even in the middle of July it is not necessary to advance more than two degrees within the arctic circle to have the sun above the horizon at midnight, and still less, if the effect of refraction be included. Even at Christiania there was no night, and we were charmed with the long serene evenings. But when we crossed the Dovre-field we observed at once the effect of above two degrees of latitude gained, and of the depression of the northern horizon. The nights were glaringly bright, and almost banished sleep. Thus day after day we chased the sun, first in carrioles, then in the steamer, till at length we fairly hunted him down, and with the fortunate concurrence of splendid weather, we finally enjoyed the arctic nights in the highest perfection.

The sail down the Throndhjems-fiord resembles so strikingly scenery of the coasts of Argyll and Inverness shires, that I must once more refer to the comparison with

Scotland as conveying the clearest idea of its character. Wood abounds more than is common in the West Highlands so near the sea. As long as the mountains on either side of the fiord are at all sheltered from the direct blasts from the ocean, the birch in particular flourished at a very considerable elevation, and descends to the water's edge.

As we approached the open sea, the hills became less bold, and at Bejan, a hamlet just at the entrance of the Throndhjems-fiord, the rock is, for a limited space, of old red sandstone, and the appearance of smoothed and rounded rocks (*roches moutonnées*) universal. This continues more or less along the coast for a great way north of Throndhjem, to the exclusion of striking cliff scenery, as the undulating character of the rocky surface is more and more strongly developed close to the sea, and even under its waves. As long rows of low rocky islets, which in very many places run parallel to the coast, have also the same character, it is easy to see that a somewhat monotonous style of scenery must be the result. These low islands or *vaers* are a singular feature of the Norwegian coast. The steamer often works its way amongst them for miles, escaping from the seeming entanglement of monotonous swells of rock by which she is at each instant surrounded, in a way truly surprising. Striking examples of this occurred amidst the desolate flats of Nord Kroken, on the second morning of our voyage, having passed in the night the great Folden-fiord, a wide inlet fully exposed to the south-west, and on that account dreaded by coasting-vessels. Here and elsewhere on this coast, the S.W. wind is more feared than the N.W., to which the coast is more directly exposed; but this arises from the sheltering ridges of rocky

islands which commonly run nearly in the S.W. direction, determining the bearing of the principal fiords and sounds. The Namsen river, well known to English salmon-fishers, falls into the Folden-fiord. The station-house of Nord Kroken stands amidst a wilderness of rounded islets, just high enough to conceal one another, as seen from ship, and giving rise to the infinity of intricate passages already mentioned.

The first object of really picturesque interest which we saw after leaving Throndhjem, is the hill of Torghattan, in the island of Torget, in latitude 65½°. It is of granite, and its form, as seen from the south, is not unlike the peaked waterproof hats sometimes worn by sailors—whence in fact its name. A view of it, as approached from the south, is given at the head of this chapter. It was, perhaps, first described by Pontoppidan, the well-known Bishop of Bergen, who, though he had not visited it himself, mentions correctly the existence of a cavern, which pierces the highest part of the island right through the centre, forming a tunnel of immense size.* This peculiarity appears to have escaped the sagacious inquiry of Von Buch,† although he mentions the island and its singular form, at the same-time ascribing to it a height much greater than it is probably entitled to. Sir Arthur Brooke‡ first described the cavern correctly, and from his own inspection. He does not, however, give the dimensions, as ascertained or even estimated by himself, except when he says that the height exceeds that of a lofty cathedral. Those recorded by Pontoppidan are, doubtless, extravagant—namely, six

* Pontoppidan's Natural History of Norway, i. 47.

† Travels (in German), i. 273. ‡ Travels to the North Cape, p. 208.

thousand feet long, and three hundred high.* The hole is directly under the peak of the hill; its general direction is somewhere nearly north and south, and it slopes materially to the northward, so that the light can only be seen through it when we approach it from that side. The course of the steamer did not, however, carry us, on either voyage, into the line of the cavern, although we could observe its general position. On nearer approach, the outline of the island was singular in the extreme. It rises from the sea symmetrically on either side, in a series of swelling humps, of nearly bare rock, which seemed at first to be absolutely destitute of vegetation, so that we were astonished to find that the island was inhabited, when we came within view of a small group of cottages in a bay on its eastern shore, accompanied by a few green fields. The swelling surface rises in a succession of heaps, to between one-third and one-half of the greatest height of the land; the whole is then surmounted by a blunted cone of perfectly bare rock, which forms the Torghattan. To take a sort of mean, amongst the extremely various heights assigned to it, possibly 1200 feet may not be very far from the truth.

There cannot be a question but that the whole of the lower region of the island (which it appears from the best authorities is not, as I had myself thought on both occasions of sailing past it, confined to the mountain and its shelving declivity all round, but stretches several miles in a northerly direction) has been abraded by glaciers, or by some similar agency. It would be a matter of interest to explore the exact height to which the *striæ* or groovings caused by the abrading force have extended, if indeed they

* *Three* hundred, not six hundred, as given in Arrowsmith's Map of Norway.

do not reach the very summit, which, from its appearance in several directions, one is almost led to imagine; and it would also be of interest to ascertain the compass-bearing of these marks. Voyaging in a steamboat is unfavourable to accurate local observations. I will therefore merely quote from my notes, written immediately after, my impressions on the subject of these "dressed" surfaces. "Already on the Throndhjems-fiord, and ever since, the most characteristic forms of the *roches moutonnées** everywhere appear. The whole face of the country presents the forms of *dômes arrondis*,† of which Torghattan may be taken as an excellent example,—but it is *universal.* Now this is the more striking, because I looked almost in vain for these forms in the Dovre-field and its declivities, where, most of all, I expected to see them. Of course I cannot pronounce on the direction of the *striæ*, which I could not land to examine. It rather appeared to me, however, that, on the coast at least, the direction of friction marked by the *stoss* and the *lee seite*† was *parallel* to the coast, and from north to south." I am aware that this statement is at variance with observations (made also in passing on a

* These are the terms used by De Saussure, De Charpentier, and Agassiz, with reference to certain characteristic forms of rocks in Switzerland, which have, consequently, become *technical* in describing a certain class of phenomena.

† Terms first used by Swedish geologists to express the characteristic impression made by the Abrading Force (whatever may have been its nature) which once swept over almost all Scandinavia, and over most other mountainous tracts in Europe. The *stoss seite* is that side of a hillock or protuberance which, having been exposed to the shock, has been, in consequence, most freely acted on and abraded; the *lee seite*, on the contrary, is the sheltered or *lee* side, over which the moving mass passed almost without resistance. In this way, the *direction* of the shock may be in many cases certainly estimated.

steam-boat voyage) by M. Siljeström,* who was attached to the French expedition to Scandinavia, and who considered that the shock came from the S.E., and describes the *striæ* as nearly perpendicular, and not parallel to the coast. His observations were made at Somnæs, a part of the mainland nearly opposite to Torghattan. Local circumstances do unquestionably produce sudden variations comparable to this; and it is quite possible that both these statements are substantially correct. Detached blocks, or "erraties"—the almost invariable accompaniments of rounded and polished rocks—are also present, though *comparatively* rare on this coast. Some good specimens may be seen on the most artificial-looking surfaces of the low rocks which rise from the sea, immediately to the north of Torghattan, and on the same side (the west) of the sound of Brönö, which we have now entered.

Beginning with Torghattan, the coast maintains for hundreds of miles a character of surpassing interest and variety. It may be said to commence with the province of Nordland, into which we enter on leaving the Throndhjem's Amt, some miles south of the place we are describing. The neighbourhood of Brönö affords many striking combinations of rock, and there is a sufficient foreground of bright green grass and other vegetation, with a few substantial houses, to give more effect to the desolate sublimity of the peaks both of the islands and on the mainland. Brönö itself boasts of a neat church; and it appears to be a place much frequented, for its secure anchorage, by the shipping which navigates this dangerous coast. Both on our northern and southern voyage—the

* Voyage en Scandinavie, &c., publié par M. Gaimard. Geographie Physique, i. 210.

weather being fine, and the wind favourable for vessels bound to the southward—groups, or rather files, of heavy-laden "yachts" enlivened the scene, all packed to an almost incredible extent with dried fish—the pride and the wealth of Nordland—bound for the Bergen market. They are remarkably square-built vessels, propelled through the water by one huge square sail, attached by a yard to the single mast—the fish being built up round the mast in the general shape, and almost to the height, of a common hay-stack. The odour of the cargo is very perceptible to leeward, even at a great distance. The sailing powers of these vessels, and their fitness for the tremendous seas which they have to encounter, is very commonly decried. I found, however, that both were spoken of in terms of commendation by our experienced and enlightened captain, who probably knew quite as much about the matter as the aforesaid critics. It does appear to me—though I speak with very great diffidence on the subject of the characteristics of a people with whom I mixed so little—that the practical sagacity and ready intelligence of the humbler class of the Norwegians has not been generally appreciated, at least by English travellers; excepting, of course, Mr. Laing, whose favourable opinion is well known; and as to boating, I certainly never felt more confidence in following a trained Swiss mountaineer over his native hills, than in entrusting my safety to the sailors either of Norway or of Shetland, who are, in fact, the same race, and whose unstable-looking boats, or "skiffs," are managed by them with such unerring dexterity. On my southern voyage, we overtook 20 or 30 of the yachts in the course of a few hours in this very sound. In addition to their square sail, they spread a

small jib to the bowsprit, and a little strip of a parallelogram sail was hung up at the stern. Though deeply laden, they made respectable way, and when light are said to sail nine knots an hour.

A few hours after leaving Brönö—having passed the striking peaks of the island of Vegö on our left, the shores of the mainland being still of smooth-shaven, rocky knolls, surmounted by cliffs and precipices—we touched at Tiötö, a remarkably flat, well-cultivated island, owned for generations by the Brodkorb family, whose hospitality has been recorded by almost every traveller in Nordland. Not long after, we reached Alstahong, a station of the steamer. Here we halted in a pretty and sheltered bay, where we found, as usual, the house of a substantial merchant, near which were some green, well-leafed trees—probably birch and alder, or the broad-leaved willow. The place looked inviting, under a pleasant sunshine, which we enjoyed. But the wilderness was not far behind; for, a short distance to the northward, rose the indescribably barren and rugged chain of mountains called the Seven Sisters, whose peaks and ravines far exceeded in savageness and desolation anything we had yet seen in Norway. The height of this range has never, I believe, been accurately determined. Von Buch estimates it at 4000 feet; perhaps it is not so great. The snow line appears to be scarcely reached, as it occurred only in detached masses and in fissures, in the third week of July. The Seven Sisters appear (from the best maps) to form an island, which occupies the entrance of the Vefsen-fiord, which issues at Alstahong. It is very difficult, or impossible, on a cursory view, to distinguish the mainland from the islands of this extraordinary coast. The island in question, called Alsteen Oe, is entirely formed by the

range of mountains just mentioned, whose six or seven distinct peaks form a ridge running to the N.W. which appear in many places inaccessible, presenting the characteristic ruggedness of the formation—mica slate—which is here predominant. The distinction between the jagged summits of the Seven Sisters and the chafed and undulating rocks at their base is highly characteristic.

It would be tedious to enumerate all the islands and headlands which were passed during the same day's voyage. The forms of the Lovunden and Threnen islands—



LOVUNDEN AND THRENEN ISLANDS.

lone rocks exposed to the swell of the North Sea—reminded me forcibly of the scenery on the west coast of Shetland, which very naturally has a striking analogy with Norway in very many particulars. The cliffs of Lovunden resemble those of Foula, seen from St. Magnus' Bay, and which I had ardently wished to visit. On the land side rose the Œxtind, a blunt cone of rock, apparently quite inaccessible, still patched with snow on the summit, and presenting one of the most striking objects of its kind I ever saw. I ought not to compare it with the Mont Cervin of the Alps; yet it is not without analogy. It rises nearly from the sea, and its base is undulated by those

same shaven and furrowed rocks which enforce, by contrast, the rugged elevation of the tops.



ŒXTIND.

The same remark applies to the island called Hestmand, or Horseman, under which we sailed in the course of the evening. Its form is singular, and is said in some points of view to resemble a cloaked horseman in profile. To us it was interesting, as announcing our arrival at the Arctic Circle. The *roches moutonnées* here sink under the waves; the middle region of the island is green; indeed, at every spot where soil could accumulate between the rocks, either of coast or island, we now became sensible of the existence of a peculiarly fresh and verdant arctic vegetation forced into rapid development by the unceasing presence of the sun. I was assured that on the seemingly bare Hestmandö the grass was knee deep. At

11 P.M. we turned sharply into the pretty bay of Rödö, with its tidy pleasant merchant's dwelling and warehouses. The coast now rose before us and on the right, with more than common majesty; and over the snowy summits of Fondalen, which were free from the slightest haze, the rich glow of an arctic summer's midnight prevailed, and kept all the passengers on deck in fixed admiration of so solemn and glorious a scene. We calculated that the sun's upper limb would not sink above half a degree during the night, and its ruddy glow never entirely left the range of snow-fields, which we were never tired of contemplating. For myself, the interest was much increased by being able clearly to distinguish true glaciers descending by the hollows of the mountains towards the level of the sea, to which, however, we could not trace them, as the intricacy of the coast concealed their lower terminations in the Skars-fiord opposite Rödö. Even at a distance I could see very well by the aid of a good telescope, that they resembled in all essential particulars the Swiss glaciers, only occurring at a level of about 3500 feet lower. They were true glaciers, not *névé;* in other words, the snow regularly disappears every summer from their surface, which is furrowed with transverse crevasses, and the whole mass descends, river-like, in the ravines, being fed by the contribution of great snow-basins constituting the "fond," as it is called in Norway, or snowy accumulations above. I felt the most lively desire to stop at Rödö, where good accommodation and a boat might no doubt be had, and these glaciers be visited in detail and without much difficulty; but it was not to be thought of; so I was obliged to content myself with many lingering glances. These glaciers were the first I had seen in Nor-

way, and, indeed, are separated by several hundred miles from the next to the south, which belong to the high mountains on the frontier of the Bergen Stift. Von Buch states* that one of these glaciers of Fondal opposite Haasvär falls *into the sea.* I do not think, however, that the great geologist—or indeed any other traveller who has published his observations—himself visited the interior of these fiords, and this interesting question deserves a minute examination.

We lingered on deck long after midnight had passed, and thus gained a sight of the magnificent headland of Kunnen, a mountain with an almost precipitous face towards the ocean, whilst its mass is connected with the mainland only by a strip of flat alluvium, giving to it the appearance of an island. During the whole night there was shed from the northern sky a warm sunset tint over the scenery—sea, rock, and verdure (for much beautiful verdure there is even here), and snow, and glacier,—whose *continuing* effect was indescribably harmonious and peaceful. Thus, in one day's voyage, beginning with Torghattan, and ending with Kunnen, we had enjoyed, under the most favourable circumstances of calm sea and cheerful weather, and a glowing midnight, an amount of majestic scenery with which, in its kind, perhaps no European coast can compare.

Our next halt was at Bodö, or, more correctly speaking, at Hundholm, an insignificant village on a little rocky creek, about a mile and a half from the church and parsonage of Bodö, which lies on the Salten-fiord, an important inlet stretching many miles landwards towards the Swedish frontier. As the steamer makes a short stay here—rather

* Travels, i. 311.

out of compliment to the aspirations of the place to become a commercial port, than because there is any real business to be done—I went on shore for some hours, both on my northward voyage and on my return, anxious to make some acquaintance with the actual terrestrial peculiarities of a country within the Arctic Circle. Once again the likeness to the Highlands of Scotland in natural features was apparent and striking, whilst the houses, which are by no means destitute of comfort and neatness, rather recall the dwellings of Switzerland. Cultivation was here tolerably systematic, and there is a very fair road, which extends a few miles inland. There were a few crops of barley and some fields of potatoes well advanced for the season, together with abundance of excellent pasture. It is to be regretted that so little attempt is made to raise green crops for the feeding of stock during the long winter. A country whose capabilities seem almost boundless in July and August for the maintenance of animal life, might surely make some provision against the rigorous season. An impression of this kind is very general amongst the educated Norwegians, with whom I often spoke on the subject. The complete absence of turnips—of which I did not see a single field during my whole journey, nor, I believe, a single specimen on the table—seemed astonishing, and yet it is certain that this crop grows luxuriantly, and ripens well. The venerable priest of Bodö, Mr. Stein, with whom I had some conversation, confirmed the view I had taken, and assured me that not only at Bodö, but much farther north, the turnip grows to great perfection. He had formerly been priest at Carlsö, in latitude 70° (where he received Sir Arthur Brooke, as related in his travels), and even there the turnip throve admirably. As it is, the horses and cattle are fed

in winter partly on dried leaves of the birch, but chiefly on seaweed, and on the boiled heads of fish. The old clergyman admitted that much might be done for the support of stock; but he complained of the difficulty of introducing any novelty into their simple agriculture, and finally returned to the primary difficulty—"here," he said, "we have nine months winter, and *three weeks* of summer!"

The familiar flowers of moor and morass were those of home, with a few additions entirely new to me, such as the celebrated *Moltibeer*, a delicious wild fruit, now only in flower, and another called the Swinibeer, in still greater abundance. The common birch, well leaved and fragrant, which grows to 12 or 15 feet even on heights exposed to the sea, is intermingled with the alder and mountain ash, and two kinds of willow, one with a broad and glossy leaf. Having been separated accidentally from my steamboat companions, I ascended a low range of hills partially covered with wood, and soon reached a solitary lake or tarn, of a very pleasing and by no means savage character. It was fringed all round with birch trees, and in the distance towards the east, I obtained an excellent view of the upper part of the Salten-fiord, and a range of mountains beyond, in the direction of the Swedish frontier, very thickly covered with snow. I sketched the most conspicuous of these, thinking that it might be Sulitelma, the highest of arctic mountains, not only in Scandinavia, but in the north polar regions, rising to 6200 English feet, according to the accurate Wahlenberg. It proved, however, that it was only that part of the same range called Blaamands-field, which is visible from the neighbourhood of Bodö, at least, unless in the clearest weather. I repeated my search on

my southward voyage, having ascended a hill considerably higher not far from the sea coast, but with no better success; a haze partially obscured the frontier range of the Kjölen. Blaamands-field appears to be the Ålmajalos of



BLAAMANDS-FIELD.

Wahlenberg and the Swedes, and is 5500 English feet high. Sulitelma and its glaciers were accurately described by the eminent Swedish botanist just named, more than 40 years ago, at a time when perhaps no other mountain in Scandinavia was equally well known, and was by him compared, with regard to the level of permanent snow, and the phenomena of glaciers, with the Alps as described by Saussure. On these accounts it deserves to be considered classical. Its very remote position with respect to habitations, its great northern latitude, its uncommon height, and, what perhaps is not without some weight, its high sounding

name, have given it a conspicuous place on most maps, and make it a real feature in the physical geography of the country, though almost exclusively known by the single researches of Wahlenberg. It was therefore with regret that I gave up the belief that I had seen this interesting landmark. I shall hereafter refer to its development of glaciers in connection with others in the north of Norway.*

From the same hill, overlooking the harbour of Bodö, I had an extensive view along the sea coast. To the southward were several mountain ranges of picturesque form stretching to the sea, and with snow lying on the upper third of their height. Seaward, and nearly opposite to where I stood, lay the very picturesque island of Landegode; whilst the horizon in the same direction, and towards the north, began to be occupied by the peaks of the Lofodden Islands, rising in forms as picturesque as those of the Threnen, but far more numerous.

On resuming our voyage, we passed some spots as green and cheerful as any we had seen in Norway, especially at Kjerringö, where there is an establishment on a most comfortable scale; but a few miles more brought us to a scene of desolate grandeur, rendered more striking by the contrast. The headland which divides the north and south Folden fiords may vie with the Aiguilles of Mont Blanc in the fantastic singularity of its forms. I have nowhere seen summits more perfectly acuminated. The principal group is arranged in what is often, though inaccurately, called a crater form—making, apparently, almost a circle of steep

* Near Bodö I observed erratic blocks of highly crystalized syenite—white granite—and quartzose porphyry. The prevailing rock of the country is mica slate.

peaks, the principal outlet being towards the sea. I have endeavoured to represent it without exaggeration in Plate II. We have here a repetition of the remarkable phenomenon described in speaking of the Seven Sisters, whose general character resembles that of the scenery in question,—namely, that these singularly precipitous mountain ranges seem to rise from a comparative level of gentle undulations, destitute of cliffs and even of angular prominences; which, being for the most part of the same formation, offer no primary solution of the obvious diversity by an incongruity of material. This is so very striking here—not only in the rocks, of which the sketch illustrates this description, but in the extensive ranges with which they are connected—that it compelled attention; and on recollecting what I had seen along this coast and elsewhere, I concluded—whilst surveying the rocks of Folden—that, as a general rule, the surfaces of erosion (whether produced by glaciers or otherwise) have a tolerably definite superior limit, as in the Alps; only here at somewhere about 1500 to 2000 feet above the sea, instead of 7000 or 8000 as in Switzerland. But the essential character is the same, and the completeness of the abrasion increases as we approach the level of the sea. The outlines which I took recall vividly the corresponding scenery near the glacier of the Aar, to which attention was first called, I believe, by M. Agassiz—the limit of the surfaces of friction coinciding, according to him, with the level of ancient glaciers, above which only the peaks of the higher mountains stood forth bare, or merely snow covered, but free from the abrading influence of moving ice. In the same point of view, the cause of my surprise on the Dovre-field, where such traces of friction sparingly appear, admitted of a satisfactory explanation. The plateau of the Dovre is at



James D. Forbes, del. C. Hague, lith.

Day & Son, Lith^rs to The Queen

MOUNTAINS NEAR FOLDEN-FIORD.

once too level and too high to favour the formation of glaciers in active motion—too level, because it has been shewn by my observations on the alpine glaciers, that the rate of progression depends on the slope; and too high, because, if ever the climate of Scandinavia was so much colder than at present, as to have glaciers on nearly every part of its coast, the climate at 4000 feet or more of elevation must have been so severe as to prevent the snow accumulated there from acquiring the true glacier character which is known to depend upon a partial fluidity combined with great pressure. Adopting hypothetically, then, the theory of glaciers to account for the singular configuration of the Norwegian rocks, it fits so far well in its different parts as to explain plausibly the phenomena; and whether correct or not, the analogy on a great scale of the line of demarcation of the rugged summits and the abraded slopes of the Norwegian and Swiss Alps, inclines us strongly to adopt a common theory in explaining both.

It is quite impossible to describe the varied grandeur of the scenery of the coast from between the Folden-fiord and the Vest-fiord, one of the greatest of the inlets on the western shores of Norway. As the steamer pursued its rapid course through a tranquil sea, and under the very rocks, new forms of mountains rose in succession, assuming more and more the true granitic character, and often nearly the volcanic, as the red colour and the forms of false craters, frequent in certain granitic formations, obtained more and more. The brightness of the green with which the shores and bases of the hills were clothed, added to the beauty of the effect by contrast with the ruddy hues of the bare summits, and the large patches of snow which still rested in the hollows; but as sunset, or rather as midnight, approached,

and the attractions of another calm and mild evening rivetted us to the deck, a still more astonishing prospect was presented to us. In approaching the station of Grötö, the steamer was navigated through a singular natural canal, of so intricate a kind, that more than once it was impossible to divine how she should be extricated; and in one place the depth of water is so inconsiderable as to be only navigable within a certain time of high water. This difficult passage, called Bringebeer Sound, saves a wide circuit; the granitic rocks have low, shaven, undulating surfaces, which conceal the distant horizon. On leaving the thriving merchant's establishment at Grötö, and emerging from the labyrinth of low islands and headlands, we find ourselves quite suddenly in the Vest-fiord, with the stupendous range of the Lofodden islands spread in a moment panorama-like before us. In but a few instances have I been so struck with any prospect. Mr. Everest has described the Lofoddens, and truly, as resembling the jaw of a shark.* From the place I describe, more than one-third of the entire horizon (125°) was occupied by the sharply defined jagged summits of this wonderful range of island mountains. The actual extent on the map, from Rost, the outmost of them, to the sound or channel which separates Hindö from the mainland, is no less than 130 English miles; and the whole of this extent is one mass of peaks, which at a distance appear inaccessible, as many of them probably are. To sketch such an outline would be all but impossible, and, if possible, could give no idea of the scene. The sun still hovered over the pinnacles of the

* "There lay before us the long range of the Lofoddens, 70 or 80 miles distant, from near Bodö, like the jaw of a great shark, so many and so jagged were their points."—*Everest, a Journey through Norway, &c.* p. 70.

Lofodden when I retired at a late hour. We were then in the midst of the great Vest-fiord, dreaded by mariners for the terrible swell of the ocean, and the real dangers of the Maelström when the wind blows from the south-west. It was now in the diametrically opposite quarter, and the warmth, the stillness, and repose of every thing, recalled thoughts of the sunny south, far more than a latitude considerably to the north of any part of Iceland. No doubt all these things wear a very different aspect according to the accidents of weather. Nothing struck me more on this voyage than the almost complete absence of low fogs, indeed, of mists of every kind, which mar so often the really grand scenery of our own Hebrides, and especially of Orkney and Shetland. Under other circumstances, with the mountain tops obscured, and the sea rolling in a heavy swell, a voyage to the Lofoddens would be far from a pleasure excursion, and I can conceive no country where the impressions of a traveller are likely to be more dependent on the weather.

In my case it fortunately happened that our return voyage was equally favoured in this respect with that going northwards; and, to avoid repetition, I shall here include what I saw of the scenery of the Lofodden group at that time. The main object of the steamer being to establish a regular communication between all moderately-inhabited places on the coast, it performs a zigzag voyage, which is favourable to an acquaintance with the intricacies of the coast. The cod fishing of the Lofoddens is celebrated all over the north. Here, chiefly in the inclement months of February and March, fishing boats, from an extent of coast of several hundreds of miles, are concentrated to the number, it is said, of 3000, manned by 16,000 hardy fishermen,

who catch in the season not less than 3,000,000 cod fish,* which are conveyed about midsummer to Bergen in yachts, packed in the manner already described. So great a concourse of seafaring people, gives to the remote Lofoddens a character of importance and a certain activity. In order to accommodate the interests of the inhabitants, the steamer regularly passes between two of the largest islands of the group, Hindö and Vaagö, to call at a place called Stejlo, on the remote isle of Ulvö, lying quite on the outer, or oceanic side of the Lofodden range, which may well be considered as one of the most remote spots in the world. The steamer having deposited its passengers and cargo, and taken up others at Stejlo, returns by the self-same track to the Vest-fiord, and resumes its northward (or southward) voyage. This considerable *détour* has the advantage not only of bringing the respectable community of Ulfö into almost weekly communication with the mainland, but it gratifies the traveller with a closer insight into the scenery and formation of these astonishing islands. The range of Lofoddens, with the exception of a few insignificant islets at the extreme end, are so closely dovetailed or articulated into one another, that they appear in every point of view as a continuous ridge of land. They may indeed not inaptly be compared to the vertebræ of an animal (the island of Rost being the *coccyx*), bare and knotted, jagged all over with processes, and united so closely as to resist at every point the insinuation of a foreign body. Right up to this formidable barrier did our little steamer urge its steady course, and grope out a channel, imperceptible until entered, between the two large islands already named. This

* These fish are chiefly dried without salt in the sun and wind, a process peculiar to the clear dry climate of Nordland and Finmarken.



James D'Forbes, del.. C'Maghe, lith.

Day & Son, Lith.rs to The Queen.

RAFTE-SUND LOFODDEN.

remarkable channel is called the Rafte-sund. It is a tortuous canal of 14 or 15 English miles in length, and always narrow, but with abundant depth of water, from which the land rises steeply, and even precipitously, on either side, but particularly on the west—perhaps the highest points of Lofodden being those of the island of Vaagö, which attain a height of between 3000 and 4000 feet, and seem to rise almost out of the waters of the Rafte-sund, especially near its entrance, which presented a scene of imposing grandeur. On our return voyage, just as the glorious beams of the sinking sun seemed to have put to flight the clouds which during the day (by an unusual chance), had concealed the higher tops, and which, dividing the peaks in two by long fleecy tracks of ruddy mist, slowly disclosed their entire sublimity as the vapour melted imperceptibly away.

The *Aiguilles* of Vaagö resemble those of Chamouni in form and general structure, being of reddish granite, and harbouring vast snow beds, and even small glaciers, amongst their clefts and ravines. One of the most striking scenes is the Svart-fiord, a small inlet on the west side of the Rafte-sund, so completely engulphed under frowning precipices, that it seemed as if daylight could never penetrate, and in the gloom of evening the eye failed to fathom its recesses. Yet even here, on a small and green projection, a group of cottages, with cheerful red-tiled roofs, and ascending columns of hospitable smoke, gave evidence of habitation, and probably of decency and comfort. I have attempted in Plate III. to give an idea of this scene as it appeared an hour before midnight. The eastern shore of the sound, though steep, is of a milder character, the hills of Hindö being covered with admirable green pasture up to the very

tops of those visible from the water, which may be from 1500 to 2000 feet high, and the lower part is garnished with birch wood and enclosed pastures. Some of the most level and fertile spots were evidently remnants of old sea beaches at two different levels higher than the present, and in one or two places mounds of debris jutted into the water, having exceedingly much the appearance of moraines. Indeed, it is in the highest degree probable that the Lofodden range, which still contains glaciers, was at one time much more thickly covered with moving ice.

The bay or sound of Ulfö, or Hasslö (for they are the same), presents a far milder aspect than might be expected from its situation. As we issue from the Rafte-sund, the eye rests on green slopes wider and opener than are common on this coast; and though here and there the snow lies in patches even to within a moderate distance of the sea, the verdure extends through and above them quite to the top of hills apparently 1500 feet in height; and as these are likewise clothed in many places with wood to a height of probably 800 feet, the summer aspect of the country is one of considerable abundance and comfort. As we called off the village of Stejlo in the very early morning, the sight of the herds of sheep, cattle, and goats, being driven to the upper pastures, quite recalled a Swiss morning scene, and were it not for the brief continuance of summer, the pasturages of the Lofoddens alone would be quite inexhaustible.

Returning through the narrow Rafte-sund, and making the circuit of Hindö, the nearest to the coast of the Lofodden islands, we resumed our northward course, which had been interrupted by this excursion, and in passing through the sound separating Hindö from the continent, we were

struck by the reappearance of the pine, which we had long since lost sight of. It grows on the sheltered or eastern side of the island, and rises, according to Von Buch, to a height of 650 feet, whilst the birch rises to at least 1400. This is indeed low, if we compare it to the limit of the pine on the north of the Dovre-field, where it is 2200, or to 3000 feet in southern Norway, but, considering the effect of the sea blast upon trees, it may be regarded as remarkable. In the interior of the country (as I afterwards learned), the pine grows luxuriantly to a great height, and even corn is cultivated with advantage—I mean in the valley of Bardu, about 30 English miles from the coast, and in a latitude little short of 69°. A colony of peasants from Gulbrandsdal have migrated thither, and are said to have found it a fertile province.

The scenery of Tielle-sund, where we leave Nordland and enter Finmarken, is much less striking than that of the Vest-fiord. A glacier, described by Von Buch,* as descending from the heights of the island of Hindö, escaped my notice. The appearance, not to be mistaken, of limestone cliffs, gives it a peculiar character, interesting not to the geologist alone. When I saw the stupendous precipices of Rollenö, composed of grey limestone below, and apparently of a sort of gneiss above, it recalled strongly the singular alternations of those rocks in the Bernese Alps, though here the strata are less contorted, and probably of much greater geological age. From hence the large island of Senjen, one of the most considerable on this coast, presents an imposing appearance towards the north. I sketched the outline of its peaks, which strikingly re-

* Travels (in German), vol. i. p. 356.

semble those of Arran, and, like them, are composed of granite. We made nearly the circuit of the island of Andorgö, and, at its northern extremity, saw a well-characterised, but small glacier, which nestles in a ravine near the summit, without descending any great distance.

From hence the lower scenery becomes richer, and, indeed, few countries possess a succession of greener and more beautiful landscapes than those which delighted us all along the sound which divides Senjen from the mainland. We passed many pretty hamlets amongst luxuriant birch woods, interspersed with cultivated fields. Klöven is the dwelling of a flourishing merchant, and looked the picture of smiling comfort; and as we steamed up the sound amidst the glories of an arctic night, about eleven o'clock, we met crowds of fishing boats returning from Finmarken, with their square sails set, dropping gently down with the northerly breeze. The midnight was superb. The sky was not clear, but the sunset tints (though the sun did not go down) illuminated a scene resembling parts of Loch Lomond or Loch Katrine, with a warm ruddy hue, which did not pass away like the transient glow of our summer evenings. Long after midnight we reluctantly retired to rest.

We passed through the narrows of the Ry Strömen whilst we were asleep, but on my return voyage I saw this remarkable strait and rapid, which I mention particularly on account of an imposing mountain, called the Bensjordstind, on the eastern or continental shore, of which the height is certainly 4000 feet—the barometrical measurement of Mr. Everest* being confirmed by a later, I believe, tri-

* Journey through Norway, p. 84.

gonometrical one, of which I was informed at Tromsö. I mention this, because considerable doubt obtains as to the height of many summits on this coast, which have only been estimated and not measured, and, judging by the eye, I should not have estimated the Bensjordstind at more than 3000 feet. This arises most probably from the simple and unbroken forms of the hills, and the absence of any objects whose known dimension gives a scale of magnitude to the eye. On the side of the strait this mountain shews an exceedingly small glacier of the second order. It appears, however, from the accounts of Mr. Everest, who ascended it, and also from information which I had on the spot, that an extensive glacier lies on the landward side of the summit. Early in the morning we found ourselves at anchor off the town of Tromsö.



LAPP ENCAMPMENT.

CHAPTER IV.

FINMARKEN.

TROMSÖ—VISIT TO LAPP ENCAMPMENT—VOYAGE CONTINUED—ULFS-FIORD—LYNGEN-FIORD—PIPPERTIND GLACIER—SKJÆRVÖ—GLACIER OF KAAGEN—QVENANGER-FIORD AND MOUNTAINS—SERENE MIDNIGHT—JÖKULS-FIELD AND GLACIERS—ARRIVAL AT KAA-FIORD (ALTEN)—CLIMATE—CHARACTER OF THE COUNTRY—EXCURSION TO BOSEKOP AND ALTEN RIVER—THE QUAENS—RETURN VOYAGE.

TROMSÖ, the only place like a town which we had seen since leaving Throndhjem, lies on the eastern side of a small island of the same name, in latitude 69° 40′. It is defended from the western blasts by the shelter of the greater island of Kvalö, which lies outside of it. The sound of Tromsö is consequently a secure shelter for shipping, and during sum-

mer it is a place of considerable activity, its port being filled with Russian and other vessels, engaged in the Archangel trade, and its population including consuls of the chief maritime powers. Its quays are lined with warehouses, built as usual of wood, and projecting into the water. Its main street includes many substantial and neat houses; the population was stated some years ago at 1500. It is said now to possess a good inn. The church is by no means so well cared for as might be desired; though Tromsö is the seat of a bishop, who however, I was informed, rarely officiates, but exercises a pastoral superintendence over his immense diocese, and was at this time absent on his annual visitation, which prevented me from presenting a letter of introduction with which I had been provided. There is an excellent school, conducted by a gentleman of talent and information, whose acquaintance I was fortunate enough to make, and in which every branch of knowledge, preliminary to a complete university course, is taught. On inquiry, I found that instruction is here given, not only in the grammar of the vernacular tongue, and in writing, arithmetic, and geography, but also in religion, history, English, French, German, Greek, Latin, and sometimes Hebrew!

The day on which we arrived was intensely hot and cloudless. It was difficult to support the direct rays of the sun. On shipboard, at noon, Leslie's photometer stood at from 90° to 94°, whether on a white or black ground—on shore, on a stone, at 85° and 86°. The temperature of the sea was 46°.5—of the air 58°, also about noon. About 3 P.M., on shore, the photometer shewed 94° on a flagstone ground, and 79° on a post 5 feet high; but owing to the small amount of reflection from the deep blue sky, this

indication (as I have shown to be the case under similar circumstances in the Alps*) gives but an imperfect idea of the force of radiation. I regretted not to have an actinometer, which I had been deterred from bringing by the reported impossibility of conveying any kind of glass instrument safely through the interior of Norway; which, if attended with risk, is by no means impracticable.† I sought shelter from the intense heat amongst the pleasant birch woods which clothe the hill immediately behind the town, which I found to be traversed by numerous walks, carefully gravelled and fenced, leading to neat summer-houses, the property of the chief merchants of Tromsö. The views over the sound were pleasing, and the manifest attention bestowed upon the condition of the pleasure ground made a favourable impression.

In the evening, a party from the steamer, accompanied by several gentlemen from Tromsö, proceeded in a boat across the sound (which is here only one-third of an English mile in width), to visit an encampment of Laplanders, who annually return to the same spot with their herds of reindeer. We landed near the opening of a valley which terminates in a hill of considerable height, partly covered with snow. It is called, I believe, the Tromsö-tind. On

* Travels in the Alps of Savoy. Second Edition, p. 451.

† I take this opportunity of mentioning that I made a considerable number of experiments on the temperature of the sea water at the surface; but having no better means at my command than drawing it up by a bucket, into which I then plunged a thermometer, I at length found that in *bright calm* weather (such as we generally had) no dependence whatever could be placed on such observations, the surface water being unduly heated by continued exposure to the sun. Thus I found successive bucketfuls drawn behind the same paddle-box to vary as much as 4°, and on one side of the ship and the other 10°!

either side of the valley, hills rise to 1500 feet or more, and are green to the top. These furnish pasture to the reindeer. The bottom is well wooded with trees of respectable growth, far superior to those behind Tromsö, and consisting, so far as I recollect, of birch, alder, and willow. There were no firs. The ground was boggy in many places, from the abundance of land-springs, which, in part at least, are alimented by the melting snows, which evidently had but lately disappeared on the shady slopes. One good spring, which appeared to rise from rock, and which might have an elevation of 150 feet above the sea, had a temperature of 37°.5.*

We at length extricated ourselves from the wood, and crossing the stream, saw the Lapp camp before us on a dry and pleasant grassy space, about two and a half English miles from the sea. Some piles of sticks and mounds, which seemed like no human habitation, first attracted attention. The figure at the head of this chapter is from a sketch on the spot. The piles of sticks form (as we found) a sort of skeleton shed, which can be enclosed in bad weather by a kind of rude tarpaulin. They contain barrels, clothes, and many nondescript utensils and stores, which in fine weather are exposed suspended from the bare poles. Two low, round mounds of turf, overlaid with sticks and branches in a most disorderly fashion, composed the habitations of a multitude of men, women, and especially children, who seemed at first sight to be countless. Their appearance—uncouth, squalid, and diminutive in the extreme—was, I thought, decidedly unprepossessing. But an attentive survey brought out some more favourable features.

* Another, not so large, and higher up, 38°.8.

The countenance was altogether unlike any I had seen, but by no means devoid of intelligence, and even a certain sweetness of expression. Notwithstanding that our party was tolerably numerous, they exhibited no signs either of distrust or of shyness; and whilst some of them entered into conversation with one of the gentlemen from Tromsö, who knew a little of their dialect, and others went attended by several small active dogs to fetch some reindeer for our inspection from the heights, the greater part remained quietly engaged in their huts, as we had found them, quite regardless of our presence. On inquiring into their occupation, we were surprised to find them possessed of some excellently printed and well cared-for books, particularly a bible in the Finnish tongue, and a commentary, each forming a quarto volume. We found some of them also engaged in writing. This was a matter of surprise, where we had been led to expect something approaching barbarism; and we had soon a proof that their pretension to religious impressions was not merely theoretical; for they positively refused to taste the spirits which were freely offered to them, and of which our party partook; though it is well known that excessive and besotting drunkenness used to be the great sin of the Lappish tribes, and still is of those who have not been converted to habits of order and religion, by the zealous efforts of the Swedish missionaries (particularly, I believe, Lestadius and Stockfleth) who have indefatigably laboured amongst them.

The characteristic composure of the people was well shown in a young mother with rather pleasing features, who brought her infant of four months old out of one of the huts, and seating herself on the sunny side of it, proceeded in the most deliberate way imaginable to *pack*

up the child for the night in its little wooden cradle, whilst half a dozen of us looked on with no small curiosity. The cradle was cut out of the solid, and covered with leather, flaps of which were so arranged as to lace across the top with leathern thongs;—the inside and the little pillow were rendered tolerably soft with reindeer moss; and the infant fitted the space so exactly that it could stir neither hand nor foot, yet made little resistance to the operation. A hood protected the head, whilst it admitted air freely. When the packing was finished, the little creature was speedily rocked asleep. The elder children were inquisitive, but far from rude, and they played nicely with one another.

The Lapp hut is formed interiorly of wood, by means of curved ribs, which unite near the centre in a ring, which is open, and allows free escape for the smoke, the fire being lighted in the centre of the floor. The exterior is covered with turf. The door is of wood on one side. The inmates recline on skins on the floor, with their feet towards the fire; and behind them, on a row of stones near the wall of the hut, are their various utensils. Their clothing—chiefly of tanned skins and woollen stuffs—looked very dirty. Their whole wealth consists in reindeer. The two families who frequent this valley possess about 700 deer. We saw, perhaps, about one-fourth of that number. A few of them were driven, for our inspection, into a circular enclosure of wooden paling, where they are habitually milked. One of the men dexterously caught them by the horns with a *lasso*, or noose. The deer are small; but some of them carry immense branching horns, the weight of which they seem almost unable to support. At this season their long winter coat of hair came off by handfuls. They make a low

grunting noise, almost like a pig: the milk is very small in quantity and excessively rich.

It was eleven o'clock at night when we left the Laplanders, and we reached the sea-side a few minutes before midnight. It was a glorious evening—the sun shining warm and ruddy across the calm sound. It was more like a sunset at Naples than what I had imagined of midnight in the arctic circle. The town and shores of Tromsö lay in comparative shadow; and as we rowed across to our steamer, we heard in the distance the not unmelodious chant of the Russian sailors, who amused themselves in boating and singing most of the night.

We sailed northwards at noon the following day, and passed under the lofty island of Ringvadsö, of which the glacier, and the origin of the name of the island, have been correctly described by Mr. Chambers, in his "Tracings of the North of Europe." The glacier has pushed before it a large moraine, which, extending quite to the sea-side, has dammed up a considerable valley—forming thereby a nearly circular piece of fresh water, which gives to the island its name. We now entered Ulfs-fiord. The mainland in advance of us is a mountainous peninsula which separates Ulfs-fiord from Lyngen-fiord. It rises in several places to above four thousand feet, and the general effect is wonderfully fine. It is the highest land in this latitude (69½°-70°) in the northern hemisphere. The summits are of course covered with perpetual snow (the height of the snow line, according to Von Buch, is fully three thousand feet), and are the feeders of numerous glaciers, which in their general aspect perfectly resemble those of Switzerland, if we except the lower level at which they occur. The first we saw distinctly was on Ulfs-fiord, on the west side of this

remarkable chain. It is the Jägervandstind glacier—so called from a small fresh water which occurs near the foot of it, and very near the sea. I examined it minutely with a good telescope. It is fed by a *névé*, which fills a very extensive rocky depression in the hills, out of which it pours in a broad, icy stream between ramparts of rock, and dies away upon the slope before it reaches the level of the lake. It has fully-formed moraines.

Passing Carlsö—abounding in white limestone, and Vandö, on whose shady side snow occurs in such quantity as forcibly to impress upon us our high northern position—we sailed round the magnificent promontory of Lyngens Klubb, or Lyngstuen, which terminates the peninsula already mentioned. The highest mountain is called the Pippertind, and from it, on the eastern side, descends the Pippertind glacier. The height has been estimated at 4000 feet;—it is perhaps more. The glacier not being nourished by very extensive snow beds, and being, moreover, precipitous at its lower part, dies away some 1500 or 2000 feet above the sea. Our excellent captain, finding a good anchorage, and the weather being beautiful, steamed into the little bay at the foot of the glacier, and allowed those who chose to land for the purpose of examining it. I soon perceived, however, that the expedition was likely to be a much longer one, and to be attended with more delay, than the captain expected, or than I could reasonably ask. The ascent of the glacier was, besides, not likely to be attended with much profit; for the kind of glacier which I most desired to visit was that which reaches nearly to the sea level, where all the peculiarities of moving ice were likely to be best developed. On these accounts we returned to the ship, after a short

excursion on shore. I was in hopes that we might have visited the glacier of Reendalen, a few miles higher up the Lyngen-fiord on the same side, which is stated on good authority to descend on a comparative level to near the sea-side,* but this was not found practicable under the circumstances. I could only, therefore, express my gratitude for the goodwill which the captain had already shown in so far favouring my researches.

I must not omit to mention that in passing the promontory of Lyngen we had a perfect, though somewhat distant view of Nord Fuglö, which rises from the open sea to a height of 2500 feet,† and is one of the most beautifully shaped islands I have ever seen. At the distance at which I saw it, it was scarcely possible to realise its great elevation, the dip of the horizon partly concealing its base. I found it impossible by any drawing to do justice to its imposing form.

The climate of the inland part of the district of Lyngen is well spoken of—corn ripening there, which it will not do at Tromsö and other places on the coast. We quitted with regret the grand scenery of the Lyngen-fiord, which we crossed with the most splendid weather, and entered the Maursund, which has a milder character, and banks of charming green. Again the scenery expanded, and as evening approached we entered the wide Qvenanger-fiord. This presented several objects of interest. The small island of Skjærvö was the first place of call after quitting Maursund. It has a pretty inhabited bay. Over it towers

* See Von Buch, i. 463. His statement (which was probably not from personal observation) was confirmed to me by an excellent authority, M. Ebeltoft, of Tromsö.

† Gæa Norvegica, p. 160.



to the westward the high Island of Kaagen, on whose eastern face hangs a very pretty glacier, reaching to within no great distance of the sea. The hills are shapely, and recall the forms of the mountains of Savoy on a small scale. A pretty extensive *névé* is formed in a hollow where the snow accumulates, and there the glacier proper is elaborated; it then works its way down through a precipitous and narrow ravine—after which, expanding slightly laterally, it seems literally to hang on the slope, in form like a frozen tear, its very shape giving evidence to its tenacious plasticity. The sight of this glacier alone, even from a distance, with its crevasses and miniature moraines visible to the telescope, would have satisfied me that the glaciers of the north, even to the seventieth degree (which is exactly the latitude of Kaagen), and those of the Alps, as low as latitude 45°, are identical in their nature.

This beautiful glacier recalled to my mind one in the Allée Blanche, descending from the chain of Mont Blanc, not far from the glacier of Miage, called Glacier de Frêne.

Opposite Skjærvö, on the mainland, is the fine group or jagged mountains called Qvenanger-tinderne. Their absolute resemblance to the Cuchullin Hills in Skye impressed me with the conviction that, like these, they must be composed of hypersthene rock, and I afterwards found, on Professor Keilhau's authority, that I was correct. Their exquisite effect in the slanting beams of the sinking sun I shall never forget. By a singular and happy coincidence, I saw the same scene on my southward voyage a few days later, at the same hour and by the same lights, in weather equally perfect, and thus it was doubly fixed in my memory. Plate IV. represents this scene. The small island in the foreground is Hagsteen. It appeared to be composed of white limestone. The upper part of the Qvenanger-fiord lying to the east of these mountains is described as being very well wooded. Von Buch compares the scenery to that of the lake of Lucerne! He found the birch woods luxuriant at 800 feet, and only entirely vanishing at 1150. There are also copper works, which are carried on by an English company, and from which, as a centre, interesting excursions might unquestionably be made, particularly to some singular glaciers in the neighbourhood. One of these is at the head of the little inlet of the Jökuls-fiord (Jökul in Icelandic, means a glacier). It is the only glacier in Norway which is actually *washed* by the sea. The detaching and fall of masses of ice into the fiord occasions frequent commotions, propagated for a distance of miles—the waves occasioned by them frequently overflowing the huts of the natives. This fact



James D. Forbes del.—C. Hague lith.

Day & Son, Lith.rs to The Queen

QVENANGER TINDERNE.

is mentioned by Von Buch,* who, however, does not appear himself to have visited the spot; but I received a particular account of the position of the glacier from Mr. Crowe, British consul at Christiania, who is intimately acquainted with this part of Norway. Another glacier, described to me by the same gentleman, is on the north side of the Lög-sund, in the Qvenanger-fiord. Not far from Jökuls-fiord is Alteid, a narrow isthmus, which lies on the regular boating route to Hammerfest, being crossed overland, so as to avoid the circuitous and often dangerous sea voyage round the wild peninsula, bounded by the Qvenanger-fiord and Stjern-sund. It is a mass of wild mountains, attaining a height of 3500 feet—exposing flat snow-covered surfaces, and pouring down glaciers on almost every side. It is called the Jökuls-field. It is singularly indented by deep fiords in all directions. These are (probably) the northmost glacier-bearing mountains on the old continent, except, perhaps, those less extensive ones in the neighbouring island of Seiland, mentioned by Everest. But towards the North Cape there are none.

With the steamer we of course rounded the peninsula, and obtained views from time to time of icy masses pouring down from the field towards the sea. Instead, however, of standing towards the shore, we took a northerly direction towards the isle of Loppen, where it will be seen by the map that we were fully exposed to the open sea. Spitzbergen being the first land (with the exception of the insignificant Bear Island), exactly 6° of latitude north of us. Yet here we had the most glassy sea and well-defined horizon, and the sun continued warm and

* Travels, (in German) i. 473.

clear throughout the entire night. It was impossible to have seen its midnight aspect more favourably, for no land interfered to diminish its apparent elevation, and I was here almost in the highest latitude which I reached, viz., 70° 20′. At midnight we were near the solitary isle of Loppen, where lives, however, a substantial and friendly merchant and proprietor, who with his family came on board. At eleven P. M., according to our but imperfect reckoning of time (so fast do we run eastwards through the narrow degrees of longitude), Leslie's photometer on the deck stood at 20°; at half-past eleven it fell to 14°, the air being 55½°. About a quarter of an hour later the thermometer fell to 50°, with a gentle breeze from the open sea; the photometer shewed first 10°, then 12°, then 14°. Some faint cirro-stratus clouds near the sun's disc clearing away, it rose to 17°, 19¼°, 20°, and finally 22°, about midnight, or very little later—the sun's disc being now free of any distinguishable cloud, and the photometer standing on an insulated barrel on the deck, therefore almost free of extraneous reflection. The glacier-clad mountains of the Bergs-fiord were bathed in the horizontal ruddy light as we stood across the open sea to touch at Hasvig, on the island of Sorö, which was our utmost northern latitude.

The Bergs-fiord mountains just mentioned form the seaward part of the peninsula of the Jökuls-field. The principal glacier which descends from them was described to me by a gentleman on board perfectly acquainted with the locality, as one of the most remarkable, and, at the same time, the most accessible on the coast. It reaches, he assured us, within a quarter of an hour's walk of the sea, and there is a safe anchorage in the Bergs-fiord, being almost land-locked by the large island of Silden. This



Day & Son, Lith.rs to the Queen.

CLACIERS OF THE NUS-FIORD.

was exactly the sort of glacier I was anxious to visit, and I hoped that upon our return voyage the captain might have taken the inner passage, and given me an opportunity of landing at a far less expense of time than our visit to the Pippertind glacier must have required; but I saw that there were objections, and I consequently lost this interesting sight.

The sound, which extends from Silden Island towards the Alten-fiord, is called the Stjernö Sound, as it separates the mainland from an island of that name. In our northern voyage we passed through it in the night, and with a strong head wind; but on our return I was enabled to examine closely the features of the snow-crowned coast. The most important glaciers succeeding those of the Bergs-fiord occur in the Nus-fiord, a small inlet of this Stjernö Sound; they also descend from the Jökuls-field. From an inspection of the drawing (See Plate V.), it will be seen that these glaciers have the true alpine character, being outlets of extensive snow-fields whose general level exceeds 2000 feet—the glaciers descending the natural ravines in the midst of slopes of the brightest verdure. They are accompanied, as usual, by moraines, or *trails* of rocky masses carried forward on the surface of the ice by its progressive motion, which also produces crevasses in the usual way, which are revealed in summer by the complete fusion on the surface of the covering of snow. It will be seen that one of the glaciers of the Nus-fiord descends to within a short distance of the sea. The view is so far incorrect that it probably cannot be seen from any one spot, at least not within the angular space represented, being taken (like most of the others) during the progress of the steamer. I in this instance took advantage of the change of position

to include within the drawing more of the two principal glaciers than I could distinctly see at any one time. The larger inlet of Oxe-fiord lies farther to the east. It is a deep indentation into the mountainous and snow-capped peninsula which I am describing; but it does not, so far as I observed, show any true glaciers, or at least they do not reach a low level. The cheerful beauty of the exquisitely green hills is very attractive; and when the steamer turned into a creek without one apparent trace of human habitation, I was reminded of the character of some of the deeply indented lochs of the west of Inverness-shire, distinguished by the abundant pasture which their hills afford; only here, the sense of utter loneliness was still more oppressive. Whilst wondering what could be our destination, as we steamed up the inlet, we suddenly turned a headland, which disclosed—in a sunny, sheltered nook beneath a steep mountain, and near the opening of a large ravine—the ample establishment of a substantial Kjöbmand's (merchant's) dwelling-house, store-houses, and jetty, displaying, as usual, the utmost neatness and apparent comfort. It is a regular steam-boat station, and is the only dwelling of any kind for miles and miles of coast. A flag was gaily flying at the top of a staff. Our arrival was greeted by repeated cannon shots, whilst a well-sized and well-manned boat pulled from shore, bringing a large party of well-dressed gentlemen and still gayer ladies, which we found to include the proprietor of Loppen, who had come on board on our northward voyage. The apparition of such unequivocal proofs of civilized life in the midst of the wilds and snows of the arctic circle had an effect not a little amusing, and at the same time delightful.

The island of Stjernö, on the other side of the sound,

contains no glaciers, and appears nearly continuous with the island of Seiland, from which it is separated, according to the charts, by a very narrow strait. Seiland closes the entrance of the great Alten-fiord, with its lofty ridges, which, however, show no snow on that, their eastern side; but on the opposite side, facing Hammerfest, it appears, from the narrative of Mr. Everest,* that the mountains rise to the height of 3400 English feet, of which the upper 600 feet are constantly covered by snow; but it is probable that its extent is too limited to furnish examples of true glaciers. The islands of Stjernö and Seiland present the same geological features with the great peninsula of the Jökuls-field, of which they form the continuation—the prevalent gneiss formation being interspersed with outbreaks of hypersthene rock. The town of Hammerfest, the northmost in the world, is placed on the little island of Qualö, divided only by a narrow strait from that of Seiland.

It was a beautiful morning when we steamed up the Alten-fiord. The little village of Talvig, on the mainland, on our right, is situated on the green shores of a pleasant bay. And here is a church, the parochial centre of a vast district, including the comparatively populous environs of Kaa-fiord, where the management of important copper-works employs a great many hands. I afterwards learnt with regret that the clergyman of Talvig was a member of the Storthing, or Norwegian parliament, and was not only now at Christiania engaged in his political duties, without having appointed any one to do regular duty in his place, but that he had actually been absent the whole of the previous winter, on the plea that if he did not go south by

* The published Travels in Norway by this gentleman contain useful and interesting observations, too hastily and concisely thrown together.

the latest steam-ship in autumn, he should arrive too late in spring for the opening of the session!

It was still blowing hard when we reached Bosekop, a water station at the eastern side of the entrance to Kaa-fiord, which is the inmost bight of the Alten-fiord. It was at Bosekop that the French expedition wintered, which was dispatched to Scandinavia some years ago on a scientific mission; and several interesting results of their journey were obtained during their long stay in the Alten-fiord, in particular, observations on magnetism, meteorology, and the aurora borealis, by MM. Bravais and Martins. The former gentleman made a very interesting examination of marine terraces, or ancient sea-beaches, which are traceable for a great distance along this coast (similar to those which I have mentioned as conspicuous at Throndhjem), with this remarkable peculiarity, that they are not continuous at the same exact level above the present sea, but *incline* in such a way as to shew that the coast has not only been raised bodily out of the water, but in an unequal manner, the part towards Hammerfest having emerged *less* than the part towards Bosekop. I cannot but mention with regret, that, considering the enviable facilities for making observations enjoyed by the officers and *savans* of the expedition, it would appear that they made but inconsiderable acquaintance with the regions they might easily have explored. For example, I have not been able to find that a single Norwegian glacier was visited by any of the party, though I may have overlooked it, owing to the diffuse and irregular manner of publication. An exploration, not only of the immediate environs of the Alten-fiord, but of the imposing mass of the Jökulsfield, and the interior of the Qvenanger-fiord, with its hypersthenic formations, its interesting clima-

tology, and important glaciers, might certainly have been looked for from an elaborately fitted out and national scientific expedition. Instead of this, they appear to have spent a period quite disproportioned to their physical interest on the inhospitable shores of Spitzbergen.

The interior of the Alten-fiord, within the headland of Bosekop, is called Kaa-fiord (pronounced Kō-fiord), and as we steamed up to the embouchure of the river, which joins the sea at its head, we had a very pleasing prospect of bold hills on either side (rising, in the case of the Haldi, to 2944 feet), with green and sheltered valleys, well wooded in some places with pine, and here and there showing a cottage or two with enclosures. On the right are situated the well-known copperworks; and just beyond, a church built expressly for the workmen of this extensive establishment by Mr. Crowe of Christiania, who formerly acted for the Alten Mining Company. The convenient house of Mr. Thomas, the present manager of the works, is placed on a pleasant slope, still higher up the creek. The steamer landed us almost close to the house, where we were kindly received by Mr. Carey and Mr. Wilson—Mr. Thomas being about to visit Hammerfest by the very vessel which had brought us to Kaa-fiord. The wind still blew strongly from the interior towards the coast, but with a temperature so mild, and in the presence of a sun so bright, that I was transported in imagination to the shores of the Mediterranean, for the peculiar softness of the air resembled nothing so much as that of the *Scirocco* of the south of France. And the thermometer confirmed these sensations. At 2 P.M., on the 15th July, it stood at 76°, the *Photometer* (Leslie's) at the same time marking from 77° to 85°, placed on grass freely exposed to the wind. On a

surface of white siliceous gravel, it marked 3° higher; but as the *zero* of the instrument shewed this day 3° too low, the greatest effect of radiation on the grass may be taken at 88°, and on gravel at 91°. The sky was bright with passing clouds. At 3½ P.M. the temperature of the air was 77°.7, and at 4½ P.M. 80°. So sultry was the air, that it seemed to threaten a storm, and we felt quite disposed to



KAA-FIORD FROM MR. THOMAS'S HOUSE.

await the cool of the evening to make any excursion. It required some stretch of imagination to comprehend the fact stated to us by Mr. Carey, that the lawn in front of the house, now covered with waving grass, nearly ready for the scythe, was still covered with the last winter's snow almost to the door only one short month before!

The aspect of the fiord from Mr. Thomas's house was now one of genial and quiet beauty—the hills all green,

with but a few patches of snow lingering near their tops, masses of natural Scotch fir woods, relieved by birch trees in full leaf, pasture fields well enclosed and interspersed with cottages, of which the inhabitants are thriving and well clothed, several gardens, including flowers as well as vegetables, a well sized church, with an almost English looking spire (for which, as already observed, the community is indebted to Consul Crowe)—and beneath all, the placid waters of the fiord, whose outline is broken by several picturesque headlands, and which is defended from all storms by the outlying islands of Stjerno and Seiland.

Mr. Thomas has, with praiseworthy perseverance and zeal, directed the formation of accurate registers of the thermometer and barometer in this very interesting and remarkable spot, the latitude of which is 69° 57′, and longitude 23° 2′ east of Greenwich, and the results have been published in part in the proceedings of the British Association; but it is still to be desired that a synopsis of the whole should be carefully drawn up, and the index corrections of the instruments specified.. Amongst other things to be wished is a comparison of the mean barometric pressure with that in lower latitudes, and there can be no doubt that this may be obtained from the comparison of the Alten barometer with those of the French expedition; and again, a comparison of the mean temperature of the air for the whole year, with that of the earth deduced from good springs, of which there are several. One of these is situated in a cellar under Mr. Thomas's house, and is stated to vary little in the course of the year. I observed its temperature with a good thermometer, having little or no index error, to be 39°.5 on the evening of the 16th July. Another good spring, near Quaenvig, some miles from Kaa-

fiord, but also near the level of the sea, or rather about 300 feet above it, gave 37°.8 on the evening of the 15th July, which agrees well with the observations near Tromsö, recorded in the commencement of this chapter. It is hence exceedingly probable that the mean temperature of the ground at least is 38°, whereas the mean temperature of the air, from observations at 9 A.M. and 9 P.M., continued for 11 years, give 33°.7, or above 4° less. This important difference has been recognised in high latitudes since the time of Wahlenberg.

I shall here add a few particulars which give a general idea of the climate of this part of Norway. For eleven years (1837-48), the average temperature at 9 A.M. was 34°.50; at 9 P.M., 32°.83; mean, 33°.66. Von Buch estimated it, solely from the upper level of the Pine (640 feet above the sea), at nearly 1° Reaumur, or 34°.25 Fahrenheit, a remarkable coincidence. The mean temperature of February, which is decidedly the coldest month, is 15°.4; and of August, which is usually the hottest, 54°.3. This range is, however, small compared with the actual extremes on particular days, which I find to be the following during three years for which they are specified, but of which those for 1848 only are certainly taken with self-registering instruments:—

	1846.	1847.	1848.
Maximum	83°.3	84°.7	86°.9
Minimum	14.8	3.1	20.2
Range	98.1	87.8	107.1

Hence, it appears that the thermometer rarely, if ever, falls below the *zero* of Fahrenheit, whilst there is not, perhaps, another part of the earth's surface on this parallel where

mercury does not freeze in winter. The fall of rain and snow in these three years was only 18.18, 16.81, and 17.19 inches.*

The heat of the day being past, I readily accepted an invitation to ride along with a gentleman connected with the mining establishment, and a lady resident in the neighbourhood, to Bosekop and the Alten river. It gave me an opportunity which I much desired of seeing something of the natural features and productions of the country, and also, as I understood, a fair example of the facilities of internal communication. A rude horse track amongst trees, or over rocks, interrupted by rivers and swamps, and often nearly undistinguishable, conducted us to Bosekop in 3½ hours (though we were not ill mounted), whence we had come by steam in the morning probably in less than one. Leaving Kaa-fiord about 8 P.M., we first crossed by a bridge a contraction of a sort of lagoon, into which the sea water runs at its head. The glen, which extends landwards in the same direction, strikingly resembles a Highland glen, and I longed to explore it, but our road lay in quite a different direction. Having passed the bridge, we ascended a steep gravel bank, dotted over with fir trees, and adorned with a beautiful plant in flower, which one of my companions told me was the *Linnæa Borealis*. These flat-topped gravelly hillocks are evidently accumulated and levelled by the presence of a mass of nearly still water. They are the commencement of that interesting chain of terraces, sometimes accumulated in hollows, at other times abraded from the face of projecting headlands, which extend at intervals nearly to

* See reports of British Association for 1849 and following years.

Hammerfest, and which have been minutely described by M. Bravais,* and more lately by Mr. Chambers.† The height of the highest of these above the present sea level, is here 240 English feet, according to the latter authority, and a second occurs about half way up the same gravel slopes. This modern accumulation does not extend very far. We soon came to the solid rock, over which a deep and rapid torrent falls headlong, in a very picturesque cascade, though of no great height. This same river has to be crossed or forded at a short distance higher up, near where it issues clear and strong from a lake of several miles in length. The river was very full, on account of the still continued melting of the snow in the interior. I felt little disposed to attempt the ford, which it was clear would nearly or quite compel the horses to swim, and after some delay a skiff was obtained, manned by a Quaen, who was employed, I believe, in charcoal-burning in the woods. It was with some anxiety that I looked forward to our return next day, when this Charon might no longer be at hand, the ford being almost within hearing of the cataract below.

Brushwood of alder concealed, except by glimpses, the lake on our right, which stretches eastwards for, I believe, several miles, having wooded and picturesque banks. An excursion which had been planned for me the following day to its farther extremity, unfortunately did not take place, or I should not have been contented with so scanty a view of a scene altogether remarkable, considering the latitude in which it occurs. Its character is quiet lonely beauty; ex-

* Voyages en Scandinavie, &c.—Geogr. Phys. i. 57.

† Chambers's Edinburgh Journal, and "Tracings of the North of Europe" (privately printed), 1850.

tended woods of well-grown Scotch firs and birches clothe the banks (the alder being mostly confined to the lower and marshy grounds), and climb to a considerable height on the bold rocky face of a ridge of hills rising abruptly to the north. As we rode by devious tracks amongst the fir-trees in the balmy air of a summer's night, my thoughts were once more involuntarily recalled to home scenery, and in particular, my recollection fixed upon the sequestered Loch Affaric, in the very centre of Inverness-shire, as possessing a character strikingly similar to the view before me. The two scenes are, while I write, perfectly present to my mind's eye; and though, of course, I can recall important differences, I believe that every one who sees both will be struck with the similarity of character and form, both in the scenery and the vegetation. I must, however, observe one striking difference which I could not but remark, although no botanist—I mean the total absence of all plants of the heath tribe, including the common *ling*. The ground was chiefly covered in the rough places where grass did not readily grow, with the bilberry and crowberry of our moors, and here and there in abundance the universal "forget-me-not" in full flower. Amongst the peculiar plants, the *moltebeer* was one of the most abundant; it grows in damp places. By and bye we nearly reached the sea again at Quaenvig (or the Quaen's bay, *vig* having the same signification as *uig* in the names of many Highland inlets, as, for instance, in the north-west of Skye), where are some cottages and green fields upon the slopes of gravel terraces corresponding to those already mentioned, and which here are very conspicuous from the sea, appearing to close in the bay with a sort of natural rampart. *

* See the wood-cut on the next page.

At and beyond Quaenvig, the fixed rocks present well-marked grooves and flutings similar to those occasioned by modern glaciers. They are best marked on the beds of limestone, which here alternate with metamorphic slates, and the general direction appears to be between N. and N. N. W. (true), subject, however, to local variation, depending on the con-



TERRACES AT QUAENVIG.

figuration of the ground; and this agrees sufficiently well with Mr. Chambers's observations near Bosekop.

After crossing the next ridge by tracks which would have scared any but Norwegian horses, we descended upon Bosekop, first through a stunted wood, then through green pastures sloping towards the north, from which quarter the sun shone in our faces over the heights of Seiland. Here, for the first time, I saw a custom very characteristic of the climate. Some cattle were reposing to the leeward of a

smouldering fire of turf, in order to defend themselves by means of the smoke from the ceaseless sting of the dreadful mosquitos which infest these countries in summer. Every night these fires are regularly lighted to ensure some repose for the herds, and it was not a little curious, in weather so warm as it was even now, near midnight, to see the poor animals closing round the embers. It is needless to add that we ourselves did not escape these torments. I had fortunately provided myself before leaving home with a large gauze veil, in which I wrapped my whole head, and I suffered on this occasion less than I expected, notwithstanding the numbers, size, and ferocity of the assailants.

It was half-past eleven when we reached Bosekop, where we were kindly entertained by a gentleman and his sister who keep house there. They are of English, or rather Scotch extraction, but have been for many generations settled in Finmarken. It was past twelve when we had finished tea; but it was not here that we had arranged to sleep, and Mr. Cole, of Kaa-fiord, who was my companion and guide, started along with me to proceed yet some miles farther, to the mining establishment of Reipas, a dependency of the Alten Copper Company. So little are day and night regarded, that no person at Bosekop seemed to think of sleeping, and our host very politely accompanied us on horseback to our destination, and even proposed to make a *détour* to show me a fine view, which I desired to postpone on the very real plea of now requiring rest. We passed some farm and cottar's houses on the way, and there we found every one astir and busy—some labouring in the fields—others constructing a house out of logs of timber. They work all night to avoid the sultry heat of noon; but as far as I could learn few people take much regular or

continued rest at this season; they say that there is time enough to sleep in winter! In fact, on our return next day at the height of noon, we found the same people engaged in the very same employments!

The space between Bosekop, on the Alten-fiord, and the Alten river, is chiefly alluvial sand.* I was disappointed with the view of the valley of the Alten, though the river is undoubtedly grand and of alarming rapidity. It overflows its banks in all directions in spring, and an extensive plain, covered with stunted willows and marshy hollows is devastated by its unchecked meanderings. Having crossed it in a flat-bottomed skiff, we traversed a wide gravelly space of this description, and passed many pools, showing that the river had swept over the entire plain during the melting of the snows. We were obliged, to my regret, to rouse the family at Reipas in order to obtain lodging, being now between 1 and 2 o'clock A.M.—a process not very easy, but which was submitted to with great good humour. After some further delay, I got to bed, and our obliging host of Bosekop took his departure homewards at that late hour.

It is evident, from my description of the banks of the Alten, that Reipas must be placed in a very nest of mosquitos. And so indeed it proved. But for my veil I should have passed a night of torment, and even with it I

* It was here that in 1850 a base of about 1200 fathoms was measured by MM. Lindhagen and Klouman in connection with the measurement of an arc of the meridian from Hammerfest to Tornea. This is only the northern division of the largest arc ever measured on the earth's surface, performed under the direction of M. Struve, and extending through 25° 20′ of latitude, from Ismail on the Danube to Hammerfest. The Norwegian part of the arc, from Hammerfest to Kautokeino, extends 1° 46′

had great difficulty in falling asleep, from the loudness of their hum, the sharpness of their bite even through the veil, and the broad daylight which, as usual, streamed in at all the windows. It appeared to me difficult to imagine that custom could reconcile any one to such a continuous infliction. Yet summer is a period so ardently desired by all—whether natives or strangers—who dwell in these high latitudes, that the plague of flies is, perhaps, considered an insignificant deduction from their gratification. More paradoxical still it does appear to any one but an angler, that the charms of sport should be sufficient to induce English gentlemen every year to spend their days and nights an unprotected prey to these savage insects; and most unexpected of all, to find a delicate English lady surrendering herself to her husband's passion for fishing so completely, as to become a willing prisoner in this terrible locality.

Refreshed by some hours' sound sleep, and having breakfasted at a late hour with the hospitable inmates of Reipas, we recrossed the Altèn and returned by Bosekop to Kaa-fiord under the oppressive heat of the mid-day sun, rendered still more relaxing by a sultriness in the air which seemed to betoken a storm, which, no doubt, took place somewhere, though we came in for but a few large drops of rain and a temporary gloom. The thermometer rose to 83° or even 84°. I was so fatigued that I reluctantly gave up the proposed excursion to the head of the lake in the Kaa-fiord valley, to which I have before referred. I walked instead with Mr. Carey, late in the evening, to the copper works, and the entrance to the galleries of the copper mines, and collected some specimens of the ore and of the chief varieties of rock. The ore is principally the common yellow

copper pyrites. The rocks consist of clay-slate, limestone, and hypersthene rock, to which may be added a peculiar sort of sandstone or granular quartz, which, according to Von Buch and Keilhau, succeeds the gneissic formation near Talvig on the west, and Altnæs on the eastern shore of the Alten-fiord, and extends a long way into the interior, forming the summit of the Nuppe Vara, a mountain of 2700 English feet. The limestone is crystalline, but not usually hard. The hypersthene rock, or hypersthenic greenstone, is a mixture of that mineral with white felspar, and the compound possesses in a high degree the toughness which gives to it its characteristic name. It is smaller in grain than most of the hypersthenes of Skye, but resembles the well-known rock of Balta Island, near Unst, in Shetland. The geology of this part of Norway has, from its metallurgical importance, naturally attracted more attention than that of most equally remote regions; but the relations of the rocks are intricate and obscure,—therefore, not to be lightly judged of by casual visitors. The rocks in the vicinity of Kaa-fiord are all more or less *moutonnées* or rounded and scored by external abrasion. The wood-cut, page 86, which gives an idea of the scene from Mr. Thomas's house, shows one of these bosses near the foreground. The promontory stretching into the bay in the middle distance is called Oskarnæs, and shows plain marks of the terraces already referred to.

The chief population of the Alten district are Quaens. A stranger has some difficulty to understand their relation to the Laplanders, with whom they are easily confounded, both being often called *Finns*. It is indeed in Finmarken itself that the Lapps are most frequently, but inaccurately described as Finns. The Quaens, however, (who, like the

Lapps, are foreigners,) properly come from Finland, whilst the Lapps belong principally to the opposite or western side of the Gulf of Bothnia. Their appearance, (excepting, however, their dress), their habits, and even their language, are essentially distinct. The Lapp is dwarfish in the extreme, and the form of the countenance resembles that of the Tartar tribes. The Quaen, or Finlander, or Esthonian, with some features in common, is moderately tall, and has a skull more of the usual European type. Their habits are absolutely diverse: The Quaen being domestic and fond of agriculture, the Lapp essentially nomadic and incapable of steady labour; so much is this the case, that some writers consider the distinction as referring rather to occupation than to race. Of the capacity of the Quaens some difference of opinion exists. Von Buch considers them to have done much more for Finmarken than the Norwegians themselves, and that they are even now its most civilized inhabitants, and by far its best agriculturists. The report of the Alten Company's officers is less favourable, but it is quite possible that mining industry is unsuited to their tastes and habits. Their language differs as much from the Lappish as Swedish does from German. Though their costume is similar, their houses, substantially built of logs, are roomy, comfortable, and of course permanent, unlike the Lapps. The appearance of the Quaens in Norway is believed not to date earlier than the commencement of the last century. They are stated by Von Buch to have been driven out of their native country by the wars of Charles XII.

The morning of my departure from the hospitality of Kaa-fiord was characterised by an unclouded sun and a rapidly rising temperature. As early as 8 A.M., the thermometer, perfectly shaded, stood at 74°.5—the photometer

on the grass at 79°. I gladly avoided a repetition of the sultry heat of the previous days by gaining the friendly deck of the Prinds Gustav, now on its return southwards from Hammerfest. I was now to part from the companions with whom I had made the journey from Christiania, and who were about to cast their lines on the Alten, unmoved by my reports of its mosquitos. I could indeed have spent agreeably the interval of fourteen days between the voyages of the steamer in exploring the valleys of Finmarken, and visiting the glaciers; but I must in that case have surrendered the chance of seeing the total eclipse of the sun at Bergen on the 28th July, which was one main object of my journey. Of my return voyage I need say nothing, as I have already incorporated from my notes what was necessary to complete the description of the whole coast. The magnificent weather which we had enjoyed during all the time that I was within the arctic circle did not desert us until our arrival at the Throndhjèm-fiord. We saw the sun first sink under the northern horizon on the night of the 21st July, in crossing the great Folden-fiord. It was one of the most gorgeous sunsets I ever witnessed, and the waters of the fiord burned with the reflection of the golden clouds; but it was the harbinger of a change which speedily took place.

CHAPTER V.

BERGEN.

LEAVE THRONDHJEM—MOLDE—AALESUND—HORNELN—ENTRANCE OF SOGNE-FIORD—GLACIER MARKINGS—SINGULAR PASSAGE OF ALVERSUND—ARRIVAL AT BERGEN—ASPECT AND SITUATION OF THE TOWN—CLIMATE—TOTAL ECLIPSE OF THE SUN ON THE 28TH JULY 1851—ANCIENT TOTAL ECLIPSE AT STIKLASTAD.

After a pause of less than two days at Throndhjem, during which I again experienced the kindest and most unaffected hospitality, I resumed once more my berth on board the Prinds Gustav, and we steered down the long Throndhjem-fiord in murky drizzling weather for Bergen. This portion of the coast, offers, on the whole, fewer grand and singular scenes than did our more northern voyage. I shall therefore not describe it in detail; but only mention a few more noticeable points. Christiansund is a clean, thriving, mercantile place, abounding in tall wooden warehouses, which project into the sea on all sides—the town being built chiefly on islands which seem to enclose completely a small basin, in which the shipping lies secure from every wind. Some hours later we reached Molde, a large village, placed near some of the finest scenery in Norway, and whose situation is pleasing and striking in a high degree. It is situated on the north-western shore

of the Molde-fiord, one of the numerous irregular arms of the sea, which intersect the whole country between Throndhjem and Bergen, and which make a land journey between those towns well nigh impracticable. Molde is a scattered village, of no great population, stretching along a coast but slightly rescued from the primitive forest which covers hill and dale in all directions with its dark green hues, and gives an air of protection and warmth to the little town thus spread out towards the sun. The fiord is broken up (as usual) by numerous islands of all sizes, and its shores are indented with endless ramifications of inlets, so that land and water seem inextricably mixed together. Still, the main fiord has an imposing effect from its extent. The coast nearly opposite Molde is characterised by noble mountainous forms, which mark the entrance of Romsdal, which passes for one of the most picturesque valleys in Norway. We saw, in particular, the Romsdal horn, which rises to a height of about 4000 feet. A well-known and striking route leads by the foot of it to the southern declivity of the Dovre-field at Lie, near Tofte.

From Molde to Aalesund, the next chief place on the coast, we sailed through channels everywhere defended from the ocean by numerous islands. The views inland disclosed once more snowy peaks in the distance, belonging to the great *boss* or mountain group which characterises the northern part of the Bergen stift, and which, from the mountains of Justedal and Lodal, give rise to, perhaps, the most extensive group of glaciers in Scandinavia. The little port of Aalesund is placed at the extremity of one of those strangely straggling peninsulas common on this coast, and surrounded by countless islands, rocks, and promontories. It has the appearance of a thriving place, with its bright

red-tiled houses interspersed with trees and gardens of the richest green, its tall warehouses, and the masts of numerous trading vessels appearing over the land in its well-sheltered inner harbour. The good fortune of our voyage had not even yet deserted us. It was a balmy evening, and all objects glowed under the influence of a deeply-tinted sunset. The entire population seemed to have turned out to enjoy it; at least one half, in boats of every size, swarmed round the steamer—the other half being seated on grassy knolls all along the shore, gazing at the busy scene of embarkation, for we took in many passengers and a quantity of goods. But though there was a great deal of crowding round the ship, and no small turmoil in disposing of the cargo, not an angry or rude word was spoken. As on every similar occasion, I saw reason to admire the native politeness, and good-humour of even the humblest classes of this truly respectable and amiable people. Opposite to Aalesund, and at other places along the coast, I observed two remarkably well-marked terraces or ancient beaches, one of which I estimated (rudely, from the steamer) to be 120, the other about 50 feet above the sea level.

During the night we rounded the promontory of Stadt, a point which projects farther into the sea than any other part of the coast, and which is dreaded in bad weather. I was called, at a very early hour in the morning, to see the immensely high and precipitous cape of Horneln, which is considered, I believe, as one of the highest, if not the highest sea-cliff in Norway. It forms part of the Island of Bremangerland, and the channel through which we pass is so narrow as scarcely to give sufficient space to form a judgment of the height of the rock. By the grey tints of

85530

morning, affording but little light and shade, it was not seen to advantage. Opposite to Bremangerland a very extensive double-branched fiord runs inland, and the whole country is intersected, in a remarkable manner, with mountain ridges, arms of the sea, and fresh-water lakes, rendering it very inconvenient to traverse, but, as I was assured by an English gentleman on board, who had visited it, highly romantic. He specified Bredeims Vand, in particular, as one of the finest lakes. This district is called, collectively, "Nord-fiord," although there is no individual fiord bearing that name. Its valleys receive the outgoings of the snowy plateaux of the Justedal mountains, in the form of glaciers, of which several are marked in Munch's map, at the head of the tributary streams of the Indvik-fiord. They are, so far as I know, as yet undescribed.

In the course of the forenoon we passed the opening of the great Sogne-fiord, the most ramified in Norway, stretching landward not less than 110 English miles, to the head of the Lyster-fiord, one of its farthest tributaries. Having heard much of the surprising and gloomy cliffs of the Sogne-fiord, I was disappointed to find its entrance tame, undulating, and without much interest, whilst the higher mountains were too remote, or too much concealed by the intermediate hills, to produce a favourable effect. The character of the rocks and islets of the fiord was, however, worthy of notice, though far from picturesque. They present to an excessive degree the forms of *roches moutonnées* —the bare grassless surfaces, dome-like or undulating, in tedious monotony, so characteristic of glacial action, with the usual accompaniments of flutings and polished channels. The material of the rocks renders these impressions of external friction still more striking, for it is

chiefly a coarse conglomerate, of which every part, the boulders as well as the cement, is cut as by the lapidary's wheel. The wonderful extent over which these appearances here occur, and the unsparing severity with which the natural inequalities of the most obdurate rocks have been smoothed down, is strikingly impressive, when we couple it with the fact that if glaciers really were once much wider spread than at present, this vast chasm was the natural outlet of an icy flood drawn from a more extensive origin than any other existing in the north of Europe.*

* These remarks were written without any reference to the following passage, in which, more than a quarter of a century since, Professor Esmark clearly described these phenomena near the embouchure of the Sogne-fiord, and attributed them to the action of glaciers:—"On this rock there seemed to me proofs of the powerful operation of ice. I found that the precipices on the side of the mountain next the sound were several [hundred?] feet in height, and perfectly perpendicular, and though they were composed, as I have mentioned, of boulders cemented together, they were perfectly even and smooth. If these precipices had been the effect of rents, attended with successive masses tumbling down, then the boulders adjoining the rent must have been found adhering, sometimes to the one and sometimes to the other of the separated masses (those which have fallen into the sea are no more to be seen), and in that case, the boulders left in one mass must have left a mark of itself in the corresponding one. This, however, was by no means the case, as the rock which remained was perfectly smooth, and had the appearance as if these boulders had been cut across by a sharp knife. I can explain this phenomenon in no other way than by supposing that large masses of ice, pressing through the sound, have cut these precipices lying parallel to the direction of the sound."—Esmark *on the Geological History of the Earth*, in Jameson's Journal, October 1826 to April 1827, page 120. The phrase in the above passage, "large masses of ice pressing through the sound," might appear ambiguous, as it might apply to drift ice as well as to the ice of glaciers. But that glaciers were intended is plain, not only from the context generally, but from the sentence with which this description is introduced, as follows:—"I shall farther mention the supposed effects of glacier ice, in another part of Norway, at the level of the sea."

The continuation of the scenery towards Bergen presents the same peculiarities in a still more emphatic degree, and is, I firmly believe, quite unparalleled. For a space of nearly 50 English miles, we navigated through a series of inlets which penetrate in all directions a low, bare, rocky land, partly island, partly continent, nowhere rising but to a very small height above the sea, and so monotonous in character, and destitute of any long reaches, or natural landmarks, as to seem to require an almost superhuman instinct for its pilotage. It is consequently regarded, I believe, as the most difficult navigation in this part of the world. We had a special pilot on board for the purpose of conducting us through it, and we observed that the admirable pilots—to whom the whole coast from Throndhjem to Hammerfest was as familiar as any highway in England to a coachman of the old school—were watching with curiosity and admiration the skill of their colleague, who extricated us with perfect composure from this enchanted labyrinth. The pilots are, naturally, the most important persons on board, for on them the responsibility of the ship is entirely laid. The navigation of the Norwegian coast, regularly performed by these excellent steamers, is not less than 1260 English miles, of which it is not too much to say that four-fifths is performed through narrow channels amidst the reefs (vär), shallows, sunken rocks, and bluff headlands of this iron-bound shore. The compass is scarcely ever used; the navigation is performed by sight alone, and is in a manner rendered possible by the short nights or perpetual day of summer. Yet fogs prevail at certain seasons, and though happily we saw none, I could easily understand the greatness of the responsibility then imposed upon the pilot, who, at such times, distinguishes almost every rock and

promontory by its peculiar physiognomy, and thus directs the vessel from point to point in safety, and with a degree of punctuality of arrival (in fine weather), at the numerous stations, altogether surprising. To expect such knowledge from the commanding officers is obviously impossible. Their main duty consists in seeing that one of the two pilots with whom each vessel is provided, is always at his post, and always sober, and for this purpose, the commander or lieutenant is always on the deck, and generally on the gangway between the paddle-boxes, which is the station of the pilot. The pilots are, of course, very highly paid; I believe above £100 sterling for their summer service, besides provisions.*

The most singular part of this navigation from the Sogne-fiord to Bergen was through the Alversund, a mere canal in the rock (entirely natural however), many miles in length, and in some places so narrow that the breadth did not appear to exceed the length of our little steamer. At one part the tide rushes through with considerable velocity. It is called the Alverstrom. At last we opened the beautiful bay of Bergen, also perfectly land-locked, with that cheerful little town before us, surrounded by green slopes and trees in abundance. The lowering sky, however, recalled my forebodings of what I was to expect from the proverbial wetness of the climate, and I immediately saw that the chance of a fine day for the eclipse was more than hazardous. We however landed without rain; and an English gentleman on board and myself were most comfortably

* I am informed that no serious accident has occurred to any one of the steamers on this coast since their establishment, some 25 years ago. It is announced that during the ensuing season (1853), the steamers will extend their voyage from Hammerfest completely round the North Cape to Vadsö, on the Varanger-fiord.

lodged and kindly treated in the Hotel de Scandinavie (kept by Madame Friis), where, however, not a single word of any tongue but Norsk was spoken.

The town of Bergen, though it has something in common with Christiania and Throndhjem, has yet very distinct features. Like the latter, it is built (one may say *entirely*) of wood; it has wooden quays and warehouses like both; it is also surrounded with woodland and pasture, but the trees are far better grown, and more conspicuous than those near Throndhjem, and the predominating character is not that of the pine-clad hills which nearly surround the capital of Norway. Every traveller has remarked that the forms and arrangement of the houses, which usually present their gables to the street, and the narrow steep thoroughfares, closely resemble the commercial towns of northern Germany, with which Bergen was formerly far more intimately connected, as it indeed still is, than with the other ports of Norway. A great influx in the fifteenth and sixteenth centuries of German traders, has impressed not only the German character upon the city, but its features upon the inhabitants. The slightest inspection shews that the Norsk blood has been here largely diluted. The people, though hardy, active, and renowned for their sea-faring qualities, have, as it seemed to me, a decidedly delicate cast of physiognomy and build (depending perhaps partly upon the damp and relaxing climate), which disappears entirely among the peasantry even of the province of Bergen itself, at no great distance from the capital. The ordinary costume of the women, and their faces, have, I thought, a decidedly Flemish cast, and the scrupulous cleanliness of the exterior of their dwellings (which are said, however, to be by no means so well purified within) increases the resemblance.

Their wooden houses are almost all painted outwardly with white oil paint, and are carefully washed about once a week. The shops, though small, are much more numerous, and seemed to me to be better furnished than in either of the other Norwegian towns, and there is far greater appearance of commercial activity in every way. A great number of vessels, including two or three steamers, were lying in the harbour when we arrived, and the annual fleet of "yachts" from Lofodden and the north, of which we had passed probably hundreds on our voyage from Alten, were coming in daily. They discharged their cumbrous and unsavoury cargoes by regulated rotation at the broad wooden quays, across which the fish is carried into spacious airy warehouses, where they are stored until shipped, chiefly in foreign bottoms, for the markets of France and the Mediterranean. The wealth and importance of Bergen, now considerably declined, arose from the extent of the fishery trade. It was, in fact, the port of Nordland, the distributor and converter of its natural wealth, and the market from whence almost all the common necessaries and the luxuries of life, as corn, groceries, clothes, and spirits, were and are conveyed by the empty yachts on their return voyage to their distant homes. Hence, naturally a close alliance has arisen between these two remote districts. The same families of fishermen and merchants in the north have dealt, generation by generation, for hundreds of years, with the same houses in Bergen.

The upper classes of society in Bergen include the staff of consuls for different states, who are naturally amongst the most wealthy merchants of the place, and whose position implies, of course, much more real business than in most Norwegian ports, where the consular duties are often

nearly nominal. Besides these, are the legal authorities of the district, whose position is important from the great extent of country which regards Bergen as its metropolis, and in which there exists not only no town but scarcely a village—the houses being solitary, or grouped in small hamlets. I had the good fortune to make the acquaintance of several able and well-informed gentlemen connected with the administration of justice—one in particular, who shewed me the utmost hospitality, and who spared no pains to make my residence at Bergen, and my subsequent journey, pleasant and profitable. The clergy, too, are an important class in every Norwegian town, and are highly remunerated, considering the value of money here. Besides the national churches, there is one where the service is conducted in German. There is a museum, of which the richest and most scientific part appeared to be the collection of marine zoophytes, formed, I believe, chiefly by the Rev. Mr. Sars, a clergyman of the established church, well known in foreign countries as a naturalist, and who at the time I was at Bergen was absent in Italy studying the animals of the Mediterranean Sea. I think I understood that he had not only obtained leave of absence from his parish, but that his expenses were paid by the Storthing. Pontoppidan, whose curious and amusing work on the natural history of Norway (which contains the description, and probably the earliest representation, of the sea serpent), was Bishop of Bergen. From seeing a specimen of a beaver in the museum, I was led to make some inquiry as to its existence in Norway at the present time. It appears that it is still found in Gulbrandsdal, and is tolerably abundant in Tellemarken and Raabygdelaget (N.W. from Arendahl). The beaver has latterly diminished so much

in numbers, that it is now by law rigorously protected for a certain number of years.

I return once more for a few moments to the position and aspect of the town. The direct connection and extensive intercourse of Bergen as an *entrepôt* between foreign countries and the high north, has been already explained. The same considerations account for its remarkable isolation in point of intercourse with Throndhjem and Christiania. With the former there is almost absolutely no commercial or other relation; and though a great many *Bergenser* (as the residents are called) have been once or twice in Christiania, it is altogether accidental and out of the common course; and, on the other hand, I found that very few persons of my acquaintance at Christiania had ever thought of visiting Bergen. To all intents and purposes, Bergen might be upon an island far removed from the rest of Norway. In fact, not one person in fifty, or more probably in five hundred, arrives at Bergen from Christiania without making not one but several voyages—short indeed, but upon the salt sea, and by no means devoid of peril at many seasons. I now speak of what may be called the *land* route—not by the coasting steamers, which between Christiania and Bergen are slow, expensive, and much more exposed to heavy seas than in the northern part of the voyage. There does not exist any thing like a road—hardly even a horse track, to the entire avoidance of water carriage between those two important towns. There is a most exposed and often dangerous sail or row of not less than thirty-five English miles in a stretch, on the iron-bound and tempest-haunted shores of the Sogne-fiord, which is seldom performed under ten hours in the height of summer, and which is one "stage" of the great post-road. Besides

this, there is one fresh-water lake and two arms of the sea, on the banks of which no road exists, and which must be traversed by boat, with unshipment of the carriage and such like inconveniences. In spring these stages are sometimes for weeks together blockaded by floating ice, so as to render all passage impracticable. I am therefore justified in saying that, to all intents and purposes, Bergen is as if on an island, remote from the mainland and carriageable ways. It is in reality on the west side of a peninsula, some 25 miles long and 15 broad, united to the mainland by an isthmus (between the Samnanger and Nord-Oster fiords) about two miles wide. The bay on which it is built opens to the north-west, but is enclosed from the open sea by a complete *double* barricade of considerable islands. On each side of the bay the hills rise to a moderate height. The most conspicuous (called I believe Olriken) is to the east, and is a sort of barometer to the people of the place. Accordingly, it was covered with clouds during my stay. The centre of the bay runs up through a very narrow creek into an expanded salt-water basin behind the town, with green smiling banks pleasingly clothed with deciduous trees, with which are connected some pretty walks and drives. A hospital for lepers, a neat and well placed building, is on the shore of the basin. Leprosy is still common in most parts of Norway, and is rather on the increase; it is a very intractable and loathsome disease. In Bergen it has always been peculiarly virulent, which Pontoppidan ascribes to the oily fish diet of the inhabitants. Indeed, he distinctly affirms Bergen (where he resided) to be the most unhealthy place in Norway; I do not know whether this character be really deserved. The town is closely adapted to the form of the coast—but numerous suburbs of rather

pleasing villas diverge in several directions. One of the most agreeable walks or drives is towards the north to Nyhavn, a charmingly situated little seaport. Here the beauty of the colouring, the softness of the air, and the pleasant aspect of groves descending to the very water's edge, and buildings projecting into it, involuntarily recalled once more the scenery of Italy. Bergen has been a fortified place, and still possesses a garrison. Fortifications, not in good repair, are placed at the two extremities of the V, which rudely represents the ground-plan of the town. A solid square tower of great strength, and evident antiquity, called Walkendorff's Tower, exists in the northern part of the town.

The climate of Bergen is notoriously the most rainy in Norway. On the other hand, it is remarkably free from the excesses of temperature which characterise Christiania. The latitude of the two towns is almost the same. The *average* temperature of Bergen is above 5° Fahr. higher than that of Christiania, the former being 46°.8, the latter 41°.5. But whilst the *summer* temperature of the two places is nearly the same, the three winter months are on an average not less than 13° colder at Christiania—a vast difference.* In short, Christiania has a far more *continental* climate than Bergen, the latter being exposed to the powerful moderating influence of the ocean, here warmed far above average by the gulf-stream, and at the same time sheltered from the cold winds by a series of ridges of mountains of considerable height. These again condensing the moist vapours from the Atlantic, temper the summer heats by frequent rains and still more abundant fogs. The amount of rain is greater than at almost any other place in

* The winter means are 36°.3 and 23°.2; the summer means 58°.6 and 59°.8 respectively. Dove's Temp. Tables.—Brit. Assoc. Rep. 1847.

Europe,* and exceeds that of probably any other spot in its own district, the climate of the most mountainous parts of the Bergen-stift being unquestionably drier. The annual fall of rain and snow at Bergen is stated at 73 inches, being five times as much as at Upsala, on the continental side of the Scandinavian peninsula.† The larger quantity of rain, however, falls during the winter half-year, whilst the contrary is the case at Christiania. The humidity of the climate is a standing joke in all parts of Norway against the "Bergenser," of whose wardrobe a great-coat and umbrella are alleged to be, even in the height of summer, the most important part; and few, if any travellers seem disposed to gainsay its reputation. I was not destined to form an exception. During the greater part of my stay it rained more or less, though not unceasingly. I should not have regarded this (having been led to expect it), but for the coming total eclipse of the sun.

It may be thought indeed unwise that I should have staked my second chance of seeing perfectly this great phenomenon (having been in a measure disappointed already at Turin in 1842), by fixing upon a place of such ill-fame in point of climate. But my journey to Norway was undertaken with other objects as well as this, and the occurrence of the eclipse in the very height of summer (28th July 1851), when alone the most interesting parts of Norway can be advantageously visited, almost compelled me to select a position on the western part of the limited track which the total darkness would trace out. On this space and not far from its centre, Bergen was temptingly

* It is still exceeded at the English Lakes, for similar reasons.

† Vargas Bedemar's Reise, i. 185. See also Schouw's *Climat d'Italie*. At Christiania the average fall of rain is about 21.2 inches.

situated, and the fortunate coincidence of the time,—within three days of the return of the steamer from Hammerfest,—gave me an opportunity which I could not resist, of obtaining a sight of the arctic regions and perpetual day. To this may be added the desirableness of observers being distributed along all parts of the space of total darkness, as well for the chances of weather as for other reasons. And, in fact, the weather at Christiania and Bergen is so often contrary, that it was quite possible that the sky at Christiania might be covered with clouds, and that at Bergen clear. Had I obtained in time all the local information which I expected, it is probable that I should have chosen a station some 30 or 40 English miles landward from the town of Bergen, where the climate is very sensibly drier. As it was, the total phase of the eclipse, which was absolutely invisible everywhere near the coast, was tolerably seen at some distance up the fiords, and particularly at Lærdalsören on the Sogne-fiord.

No such good fortune attended me at Bergen. I was consoled for the disappointment, as far as was possible, by the unaffected kindness and sympathy of my friends there, who, with truly Norwegian courtesy, seemed to feel much more on account of a stranger who had travelled so far, partly for the express purpose, than they did upon their own. Some notice of my intention had, it seems, been circulated in a Christiania newspaper some time before, so that I found my coming fully expected, and all parties anxious to accommodate me to the utmost. The commandant of the troops most politely reserved for me a clear space on one of the old bastions, which I have before mentioned, named Friedrichs, and caused a tent to be erected for the protection of my instruments. Thither I

repaired shortly before the time of total darkness, accompanied by my friend Captain Lous of the Prinds Gustav steamer, whose courtesies had by no means ceased when his comfortable vessel was no longer my home, by several Bergen friends, and by an English gentleman in the same hotel, the only other countryman, I believe, in the place. The morning had been rather brighter than some previous ones—before 12 o'clock the sun had even shone gaily at intervals—but the clouds were throughout so menacing that no one derived thence much confidence for the afternoon. The body of the sun was visible, however, for a little after the commencement of the eclipse (calculated local time, 2 h. 17 m. P.M.), but it soon became more and more overcast, a portentous sort of calm commenced, exactly as occurred in 1842, the clouds being almost motionless. Indeed, the rapid withdrawal of the sun's heat tends itself to defeat the anxious gazer, and to turn the scale of chances against the visibility of the phenomenon.

As the hour of commencing total darkness (3 h. 21 m. P.M.) approached, the whole sky became uniformly bespread with dense clouds. The rapidity of the consummation was not so great as I had observed in 1842, which was easily accounted for by the diffusing effect of the thick curtain of vapour which already absorbed so much of the sun's direct light. There was a tendency on the part of those near me to feel disappointed at the degree of darkness, but this was because they were altogether unprepared for the nearly sudden transition from day to night which takes place at the instant that the moon's edge conceals the very last portion of the sun's disk. When that really happened, it was impossible to have any doubt to within perhaps a half, or even a quarter of a minute, from its mere effect on sur-

rounding objects. The calculated deviation of total darkness was 3 m. 37 s. Our position commanded not only a general view of the country round, but particularly of the town of Bergen itself. The houses which compose it are (as has been mentioned) almost all of wood, and painted white; and the particular hue of the scattered light during the middle of the eclipse was remarkably brought out by this circumstance. It appeared to me of decidedly a blueish tinge, remarkably cold and unnatural. A fire which happened to be lighted in a ship-builder's yard, and which before had been imperceptible, now threw out a striking red glare. Our countenances appeared wan and colourless; a chilly feeling caused an involuntary shiver. One bat, escaped apparently from the rents of the fortress, flew about us very energetically; but some sheep grazing near, were remarked not to be sensibly disturbed. There was a considerable concourse of people of all classes, but I did not observe any signs of strong emotion. It is not, indeed, the character of the people to express it. The approach of the eclipse had been denoted by the appearance of a great black cloud in the N.W., which gradually rose above the horizon like an approaching storm; but its boundary (for it was merely the shadow in the sky) was too vague to produce the appalling sense of the onward movement of a real substance, with a speed exceeding about one hundred fold that of the most rapid railway train, and making right for the spectator, as I had observed on the plains of Piedmont on occasion of the total eclipse of 1842. But the restoration of the light—the new dawn, when the shadow of the darkness had passed by—was perhaps quite as grand: a *copper-coloured* aurora rose in the N.W., shading off the ill-defined limits of total obscu-

ration, and in a few seconds more we were left in the dull dusky atmosphere of Bergen, which soon resolved itself into its accustomed elements of rain drops.

As to the real amount of the darkness at the greatest, I cannot speak with much exactness. I had indeed provided myself with an apparatus, intended to afford some tolerably definite conclusion. But, except with a clear sky, the result could have had no scientific value. As a popular estimate, I may state that, during the total phase, I found it impossible to read a portion of rather small English newspaper type (about the second smallest size commonly used in the "Times"); and I had to approach within two feet of a card, on which were printed sets of parallel lines, in order to distinguish that the widest and strongest group consisted of lines at all, and were not a mere shading. About ten minutes after the totality, I could discern these same lines as well at 15 feet off.

Before closing this chapter, I will mention a circumstance which added considerably to the local interest felt in this total eclipse. When a total eclipse was last visible in Norway I am unable now to state, but the popular mind, with singular fidelity to its time-honoured traditions, at once recurred to one which occurred more than eight centuries ago, and which, owing to the peculiar circumstances of the time, was recorded in the Sagas, and has been traditionally recollected ever since. It happened, as has been placed beyond a doubt by the careful and ingenious researches of Professor Harsteen of Christiania, on the afternoon of the 31st August 1030.* King Olaf the saint (canonized for his efforts to introduce at the point of the

* Professor Harsteen's results are detailed in Schumacher's *Astronomische Nachrichten, Ergänzungsheft*, 1849.

sword the doctrines of Christianity among the heathens of Scandinavia) engaged in battle on that day with his rebellious subjects, who were urged on by Knut, king of Denmark and England, who desired also to acquire Norway. Olaf was returning from Sweden with the troops he had collected, and entered his own dominions not far from Throndhjem. Meeting the revolters, led by three powerful chiefs, at Stiklastad, in Værdal, about sixty English miles north-east of the capital, he gave them fight, was defeated and slain. In the chronicle of Snorre Sturlason, it is related that "the weather was fine and the sun shone clear, but after the fight began, a red hue overspread the sky and the sun, and before the battle ended, it was dark as night." One of the *skalds* or poets thus expressed it, "the unclouded sun refused to warm the Northmen. A great wonder happened that day. The day was deprived of its fair light." The body of Olaf was secretly conveyed to Throndhjem (then called Nidaros) and interred. A chapel was afterwards built over it, which is now included within the east end of the cathedral.

This narrative recals that of the eclipse of Thales, which, occurring in the midst of a fight between the Medes and Lydians (B.C. 585), struck both parties with such terror, that they made peace at once. If the eclipse of Stiklastad was less impressive, it was owing to its shorter duration. That it could have been nothing short of total, appears from the circumstance that the combatants could not recognise one another; but the total darkness lasted, by Harsteen's calculation, only twelve seconds, the eclipse being even annular at some other points of the earth's surface. It was universally regarded, however, as an evil omen. Both these eclipses serve to fix with accuracy the date of

remote and important historical events, and they give authority to the chronicles which describe them, and furnish valuable corrections to the lunar tables. Mr. Airy (the astronomer royal), who has been more fortunate than myself in witnessing the total eclipses of 1842 and 1851, and whom no one will accuse of exaggeration, affirms, in speaking of the moral effect of the total eclipse of Thales, that "the phenomenon is in fact one of the most terrible that man can witness, and no degree of partial eclipses can give any idea of its horror." In this I entirely agree with him.

CHAPTER VI.

THE HARDANGER-FIORD.

LAND JOURNEY TO OOS—OOS TO TERØE — RECEPTION AT THE INN — KVINDHERRED-FIORD ROSENDAL — TRACES OF ANCIENT GLACIERS — METHOD OF CATCHING SALMON MORANGER-FIORD — BONDHUUS — THE GLACIER AND ITS MORAINE — OEVREHUUS PASSAGE OF THE GLACIER OF THE FOLGEFOND TO TOCKHEIM—ODDE—THE SÖR-FIORD ULLENSVANG—UTNE—GRAVEN—SCENERY—VOSSEVANGEN.

THE day after the eclipse I left Bergen on a journey to visit the scenery and glaciers of its rugged fiords and mountains, and finally to make my way to Christiania. For this purpose I left my carriole (which I had driven originally from Christiania to Throndhjem, and brought by steamer from the latter place) to be conveyed to Lærdal-sören, near the head of the Sogne-fiord, by a small steamer which plies weekly at this season between that village and Bergen. I was strongly and wisely dissuaded from the temptation of making that easy voyage, which is comparatively uninteresting, besides leaving altogether on one side the important district of the Hardanger. I was equally well advised to be quit of my carriole in the meantime, as

by far the greater part of the journey was performed in open boats, where even a carriole is a serious incumbrance.

The province of Bergenhuus is (as already intimated) cut off by nature from the rest of Norway. A range of most rugged mountains, crossed by but one road, divides it from the provinces of Christiansand, Aggershuus, and Throndhjem; and the space thus cut off is not only in almost every part embattled with mountains and scarred with chasms, but the ocean seems to struggle step by step for possession with the dry land, thrusting its many-fingered arms into the very heart of the country—not rolling its waves upon green slopes and shores which invite cultivation, but dashing them against the breakers, or lying in motionless pools at the foot of impending cliffs inaccessible to man or beast. It is amidst such scenes that the character of the Norwegian landscape may be rightly appreciated, and the two great fiords of Hardanger and Sogne afford the best inlets to it—the one lying to the south, the other to the north of Bergen, and the character of both increasing in wildness as we recede from the coast.

I considered myself remarkably fortunate in obtaining, through the unwearying kindness of my friends in Bergen, not only an itinerary which should conduct me in the shortest possible time to the spots which were likely to interest me most, but the companionship of a gentleman of education and of the most amiable manners, a native of Bergen, himself partly acquainted already with the country, and who had intended making a tour in the same direction. I considered this combination of our plans one of the most fortunate circumstances of my journey. For it was hardly to be expected, in these wilds, that I should meet (except here and there) with a single person talking

any language but Norwegian, with which I was almost entirely unacquainted; and every one who has undergone the misery of travelling alone amongst people whose language he knows even slightly, who are unaccustomed to see many strangers, to understand their wants and wishes, or, above all, the value of their time, at once comprehends how much I gained, not only in physical comfort, but in instruction about the objects of my study, in insight into the character and habits of the people, in economy of time and the avoidance of numberless and irritating mistakes, by the presence of an agreeable and communicative companion.

Our journey commenced under no flattering auspices. The lowering weather of some previous days broke into downright rain when the eclipse was over, and the following day it fell in torrents, with a hopeless continuity which seemed quite familiar to the denizens of Bergen. Wisely, as it proved, though not without some misgiving, I resolved to persevere; and, as the air was pleasant and calm, we jogged on in a gig holding two persons (a luxury only to be procured in large towns), which was engaged to take us as far as Oos, 2½ Norsk miles (17 English) south-west of Bergen, on the way to the Hardanger-fiord. Our conductor, or horse-boy, stuck himself on behind in an anomalous position, and soon became drenched to the very skin, which did not discompose his cheerfulness. He and my friend D. kept up a running conversation the greater part of the way, the sole subject of which, I was told, was the physical and moral excellencies of the animal we drove, and which, at every gentle rise of the road, our little friend jumped off to caress, and to put his hands under different parts of the harness, where, if he found the slightest trace of perspiration, he would say some imploring words to my friend to

spare the toil of his beloved animal. This dread of exposing their horses to unnecessary labour—amiable in moderation—becomes ludicrous when carried to the excess which it is all over the Bergen-stift, where boating is the usual mode of conveyance, and where men submit themselves, and even their children, to the most prolonged and fatiguing exertion, but cannot bear to see a hair turn on their favourite pony's coat.

The road from Bergen issues through an old gateway, and is there adorned on each side with well-grown trees in full leaf, and green and cultivated fields, with not a few pretty villas—the lagoon of salt-water formerly mentioned lying to the right of the road. The growth of grass in the fields is abundant to rankness, but the attempted grain crops of oats and barley were prostrated by the heavy rain, and gave no hope (now on the eve of the month of August) of ever becoming ready for the sickle. The formal allées of trees and the trim villas were left, and we soon came into a wilder and opener country, but still exceedingly pleasing, well wooded with birch and alder, and shewing, here and there, a farm-house or country residence of a proprietor. Among these is one belonging to an English gentleman, who often spends the summer at Bergen, and his property might well pass for an elegant retirement in the Highlands of Scotland, with an excellent garden, well-fenced fields, and pretty natural undulating ground, with dells and knolls, streams, and little tarns, overhung by beautiful birch trees, and with bold, bare hills in the distance. We soon passed on our left hand the great road to Voss and Christiania, and continued forwards on the road which, by courtesy, is said to lead to Stavanger and Christiansand—though how much of the way is on water, and how much

on solid land, let those who have travelled it say. We halted awhile amidst still pouring rain at Birkeland, to refresh the horse, and then, descending a hill, drove close by the eastern side of a pretty lake, after which we came amongst a series of wooded knolls of considerable height and steepness, which called forth from our guide expressions of the warmest sympathy and admiration for his horse, whose task we were of course expected to lighten by walking up all the hills. I made some feeble attempts to geologize, for we were now on the borders of one of those remarkable diallage formations, which are interesting features in Norwegian geology, and especially in the Bergen-stift, where they are usually associated with the mica and clay slates. But the annoyance of having to leave one's carriage and move about in soaking rain, and the impossibility of consulting books and maps under those circumstances, soon made me give it up. Indeed, the only specimen of this remarkable diallage formation which I collected, was in the streets of Bergen, where, finding a loose pebble, I did not rest until, to the no small disturbance of the neighbourhood, a hammer was found, and a piece broken off it. The formation is described incidentally in Von Buch's journey,* and more particularly in Naumann's Travels.† I observed the boulders from the carriage before reaching Birkeland, but, hoping to find the rock *in situ*, I neglected to secure specimens.

By the time we reached Oos (17 English miles in

* German edit. i. 479.

† Reise i. 132, &c. and ii. 108. It would appear that Naumann was not aware of Von Buch's distinct account of this formation, given with his usual mineralogical precision, or he would not have fallen into the error of supposing that true diallage does not belong to it. His map, too, appears not to agree entirely with Von Buch's description.

four hours!) it was fair, and fortunately perfectly calm. There is a pleasant little inn at the water's edge, and we lost no time in ordering a boat to be got ready to convey us to the island and water-station of Teroe, on the way to the Hardanger-fiord, and in procuring what materials for dinner the house afforded, which were scanty enough; but I had brought an ample supply from Mad. Friis' comfortable inn at Bergen. After a delay of two hours, a four-oared boat was procured, Oos being a regular water-station, the host (as is very generally the case), the "skydskaffer," or the responsible provider of boats and rowers at a fixed price. The rowers are taken in regular routine; therefore a stranger who has not sent a "forbud" may have to wait for a considerable time until the peasant, whose turn it is to be employed, has been sent for, even though others might be close at hand. If a forbud has been sent, and the party does not appear, the "skydskaffer" must, in the first instance, pay the "ventipenge" or waiting money, although he has recourse against the real debtor if he can find him. This change of purpose very rarely indeed occurs amongst Norwegians, but with Englishmen occasionally. I had the mortification of hearing at Oos, that an Englishman, after ordering a boat or boats, had, with culpable negligence, amounting to dishonesty, evaded payment, which the innkeeper defrayed from his own pocket. I have never since ceased to regret that I did not pay this small amount, as some reparation for the injury which such conduct by an Englishman entails upon the character of his countrymen.

It was half-past three when we started, and we had three Norsk miles (twenty-one English) before us to Teroe, without a hope of hoisting a sail, the little wind being con-

trary. I therefore readily agreed to take four rowers, that we might not arrive too late. I had been a little puzzled by the recommendation I had before received, not to take less than three men; for it never occurred to me that with heavy boats and heavy seas each man would work a pair of oars at once, which is the invariable practice, and this was the only occasion on which I took more than three rowers. There was no reason, however, to regret it. The Strande-fiord is wide and open, though sheltered from the ocean by a strong barricade of islands; but its surface is sufficiently large to admit of a heavy sea running. The weather was, fortunately, nearly calm, and we had but a slight shower in the course of crossing this arm of the sea. My companion gave me the benefit of his experience, in causing the stern of the boat to be arranged with straw and coarse blankets, so as to afford a very comfortable reclining seat, on which we lay, covered up with a carpet or sail. A little attention to these arrangements beforehand is quite invaluable in the long-run; and it is surprising how little we afterwards suffered, even in heavy rain, with the aid of our umbrella. The broad fiord was at length crossed, but we were still but half-way to Teroe. We halted at the entrance of the Log-sund to refresh the men, and I landed for a few minutes upon a rocky promontory rising from the water and entirely covered with glacier furrows.

After a pause, during which the sailors supped on the never-failing "flad brod" (a thin cake of rye meal) and butter—which they took from wooden chip boxes which are remarkably firm and light, and are used in Norway for innumerable purposes—we entered the narrow and highly-picturesque Log-sund, which divides the island of Tysenes from the mainland. It somewhat resembles the Rafte-sund

in Lofodden, only while the high grounds are infinitely less rugged and sublime, the shores have a rich Swiss character of scenery, more striking in its way than I had yet seen in Norway. Woods of dark fir clothe the slopes and overtop the cliffs, interspersed occasionally with cottages and saw mills; and about the centre of this curious passage is a snug "Kjobmand's" residence, with its jetty and warehouse. A very strong current from the southward, and a freshening breeze in the same direction, made our passage a long one; and to escape their force our boatmen crept close in-shore, exerting all their strength to pass the headlands, but thus greatly increasing the direct distance. All these promontories were strongly marked by striæ and furrows, and the evidence was conclusive that the force, of whatever kind it was, which acted so powerfully in smoothing and abrading the rocks, had passed *from* south *to* north, and not in the contrary direction. Considering the position of the Log-sund—nearly parallel to the general run of coast, and terminating at each end in a wide expanse of water—the conditions under which this force was exerted do appear singularly anomalous. Numerous boulders lie in many places on the dressed surfaces. When we emerged from the narrows of the Log-sund into a wide fiord, the evening was advanced; and the breeze having freshened and being still a-head, we made little progress, and the motion became unpleasant. At last we got under shelter of the little island of Teroe, and landed near ten o'clock, at a well-built comfortable house, which is also the steamboat station for the Hardanger country.

For a place of public entertainment, our reception was not the most hospitable. In fact, but for the energy and address of my Norsk-talking friend, I should have found it

impossible, I believe, to get anything to eat, if indeed I could have had a bed. This was partly explained by the fact, that the landlord was very ill at the time in the house; but it is also true that these stations, or houses of call, are very profitable in a mercantile point of view, and usually occupied by persons of substance, who care little or nothing about casual travellers, who are few in number, and whose custom is little worth; but it is a condition of their holdings that travellers shall be entertained; and though the natural hospitality of the Norwegian character commonly renders this no hardship, still there are exceptions, and of these the landlord of Teroe is (as I afterwards learned) a well-known one in all the Bergen country. The rooms and beds were as clean and nicely decorated as in a Swiss inn, and the perfect composure of the matron—who waited on us to the extent that her own convenience allowed—and her exquisitely tidy and becoming costume (such as I now saw for the first time) reminded one strongly of some of the remoter Swiss cantons. The cap of the Hardanger peasant is of singular form, and of thick blue cloth, embroidered; it rises like a sort of flat horse shoe above the head, the cloth being stretched over a frame of some sort to give it that figure. The dress is of the same material, very neatly embroidered with red and white on the breast, arms, and waist.

Our next progress was to ascend the great Kvindherred-fiord, which is the exterior part of the Hardanger-fiord, and with it forms one of the greatest *sea lochs* in Norway. Teroe lies exactly at the entrance of it. Our boat had been ordered over-night, and was punctually ready. About seven we started for Bondhuus, distant three Norsk miles. The morning was hazy, but we had not advanced far before

the uplifted vapour rolled over the peaks and islands, giving promise of a splendid day. Now indeed we rejoiced in having broke through the spell of rainy weather which seemed to tie us to Bergen. We rowed close under the high cliffs of the northern shore of the Kvindherred-fiord, which gradually took a milder character, and were covered with brushwood and deciduous trees. Opposite, was the pretty bay of Kvindherred, with its church, and the castle of Rosendal, an ancient baronial residence, celebrated in all this country for its amenity amidst some of the sternest and wildest scenery of Norway. I had a letter for the proprietor, which I longed to present, but to avail myself of it would have consumed this day at least; and, in this country particularly, time and weather wait for none, and urge the traveller onward to make use of the present opportunity to attain the objects of his excursion, though he might linger for weeks in the enjoyment of the hospitable welcome which, with suitable introductions, he is sure everywhere to receive. This lesson of self-denial was oftentimes repeated (sometimes under circumstances which rendered obedience to it difficult) during the next fortnight.

Majestic mountains rise behind Rosendal, and extend in an irregular chain towards the north-east, forming the well-known range of Folgefonden; but the perpetual snow from which they take their name (*fonden*) scarcely appears from below, as it lies on their flat summits, or is concealed by nearer heights. Passing the large island of Varalsoe on our left, which divides the fiord into two branches, we rowed across to the southern shore, the day being warm and dead calm. From the promontory of Aarsnes we kept close in-shore in the direction of the Moranger-fiord, where

lies the hamlet and glacier of Bondhuus, which was our main object to-day. All this coast displays *roches moutonnées*, channelled and scolloped surfaces of rock, to an extent which cannot fail to strike even a superficial observer; and the perfection and sharpness of these marks of abrasion is more and more remarkable as we approach the glacier-bearing ridges which overhang the Moranger-fiord. This fact is very striking and undeniable, as well as the greater height above the sea to which these markings extend, the direction of the action being evidently *down* the fiord, especially at a point called Svoldal, where the surfaces of abrasion are most extensive and well-marked. They not only reach a high level, but are further characterised by numerous detached blocks, rounded at the corners, overlying them. Near Œnes are some remarkable terraces. Here I first observed a sort of erection on the shore, with which I afterwards became familiar. It is a kind of rude scaffolding of trunks of trees projecting over the water of the fiord at a very considerable height above its level. It is placed at the outlet of some stream or rivulet, which salmon frequent to spawn. A man stands for hours on his high look-out, watching intently till he sees a fish beneath him, when he raises, by means of a counterpoised lever, a net which secures the fish.

A little way up the Moranger-fiord, on the right hand, we pass a waterfall of extreme beauty at Fureberg. Besides numerous leaps, it presents the most splendid sheet of white foam which I have ever seen, literally *clothing* a precipice of immense superficial area with its ever-changing and graceful drapery.* I have not seen many of the higher

* "A waterfall, if united and extended, is *drapery*, as much as silk or woollen stuff is."—*Modern Painters*, i. 59.

and more-renowned Norwegian waterfalls, but I doubt whether any of them unite more grace with grandeur than this. The ascent of the fiord is interesting. Our men became indolent, as it was still early in the day, and consequently we did not reach Bondhuus (on the east bank) until two o'clock. The hamlet is some hundred yards from the shore. It consists of a number of very primitive wooden houses arranged along a rude sort of street. We had some difficulty in finding John Bondhuus, the peasant, to whom we had been recommended as a guide for the glacier. It was fortunate that we did not start without one, as many Englishmen, unable to speak or understand the language, might naturally enough do.

The villagers were almost without exception engaged in cutting their hay crop, of which the fertile and sunny slopes yield a good harvest, and they are carefully fenced and cultivated, reminding me again most intimately of a Swiss scene; and the importance of a precarious day of fine weather was in this climate evidently so great that it was with reluctance we impressed the services of the venerable old man to whom we had been addressed, and who prepared to accompany us, together with his little grandson. His was a most picturesque figure—very tall and once muscular, but still erect, and with a commanding, yet mild and sombre expression of countenance; his health was evidently bad, and he had recently lost his wife. His thick and long hair hung down his neck. Our path to the Bondhuus Bræ (or glacier) lay right up a lateral valley, at whose opening the little village is placed, and from which a foaming torrent of no small size rushes to the sea. We began at once to ascend a very steep mound of *débris*, with a level top, which closes the valley. This is an un-

mistakeable *moraine*, composed of gravel and blocks of all dimensions pushed on by the glacier at a time when it extended almost to the sea, or nearly three English miles beyond its present limit; and the steep *talus* already mentioned, is the natural slope of what has evidently been at a remote period the *terminal* moraine of the Bondhuus glacier. This appears not only from its composition and numerous superimposed blocks, but from its ground-plan, which is concave towards the origin of the valley, and further, from a repetition farther up the valley of several similar concave mounds of blocks, marking positions of temporary pause of the glacier during its retreat towards its present limits. These phenomena, as must be well known to all who are acquainted with the Alps, or with descriptions of their glaciers, have their exact counterpart in Switzerland and Savoy. There is scarcely a considerable glacier which has not left unequivocal traces of its former wider extension in the form of terminal moraines more or less blocking up the valleys, and usually three or four of these concentric barriers may be discovered. In the Bondhuusdal care is necessary to distinguish some enormous stonefalls from the cliffs which overhang both sides of the valley, which might easily be mistaken for moraines, but for the more angular forms of the blocks and the inclination of the heaps descending from the sides of the hills whence they are derived.

The views are very striking and alpine; the glacier is always the principal object, even from the sea. It descends at first gradually from the snow-fields of the Folgefond between two precipitous rocks, and falls steeply into the valley, with a slope comparable to that of the Glacier des Bossons descending from Mont Blanc. The drawing, Plate VI., shows its appearance from halfway up the valley.

After ascending a steep mound of immense blocks—probably a moraine, but partly, perhaps, fallen from the cliffs—we come to a pretty large lake, which must be crossed in a boat; for not only are the sides nearly impassable, but they are seamed with foaming torrents which are absolutely so. Without a guide, then, we should have been completely at a loss. Old John led us to a little creek amongst the huge boulders which form the dam of the lake, where lay a miserable, leaky skiff, the larger boat being at present on the farther side in the employ of the people who tend the cattle at a *sæter* or *châlet* on the high mountain pastures near the glacier. Three grown men, a boy, and a dog, were quite a sufficient load for our frail bark, and I was not sorry to arrive at the farther side in safety. The view from the lake was most striking in all directions. It is situated in a deep amphitheatre of hills, well wooded to a height of, I suppose, 1500 or 2000 feet above the valley, with spots of pasture interspersed here and there. Above are bare and sterile rocks with patches of snow, and the head of the valley is closed in, as already mentioned, by the gleaming coronet of the perpetual snowfields of the Folgefond, of which the edges generally alone appear, except where the glacier forms an outlet for the superfluity of the winter's supply. Four or five large cascades intersect the woods with an unbroken band of foam and loud uproar on different sides. The shores of the lake are steep, strewed with blocks, and nearly impassable. The view towards the sea is milder, but equally picturesque; the valley narrows so much in that direction as almost to form a gorge, which is blockaded by the vast accumulations of *debris* already referred to, which form the barrier of the lake, and conceal the course of the valley beyond;

but over it we have the fine forms of the bold hills, on the other side of the Moranger-fiord.

Arriyed at length at the extremity of the lake, we ascend anew a mound of blocks, probably a moraine, immediately in front of the glacier. The torrent to which the glacier gives rise is on our left. We soon came to the *sæter*, where people tend their cows and preserve milk during summer. No one was within, but we entered and examined the rude interior of the two huts, constructed of loose, ill-fitting stones, under shelter of an overhanging rock. The arrangements were precisely such as are seen in the poorer Swiss châlets, and not at all more dirty. At last we reached the glacier, and I was surprised at the height we had ascended, in which, from a distance, I had been altogether deceived, especially by the intervention of the lake. The height above the sea (estimated by the aneroid barometer) to the foot of the ice is 1120 feet.

The whole appearance of the glacier is perfectly normal, and such as we find in Switzerland. The ice is thoroughly well-formed, and of as fine a blue in the cavities as I almost ever saw. A torrent issues from an arch at the bottom. The veined structure is quite well defined and characteristic, but not greatly developed, except close to the ground, as in the Glacier des Bossons and similar cases where the glacier is not closely confined by lateral barriers towards its termination. Its inclination is steep throughout. I noticed the mark of last winter's moraine many fathoms in advance of the present limit of the ice, which, however, is now gaining ground afresh, driving a little moraine of five or six feet high before it. This, I presume, is the natural course of things. In spring, the

melting of the ice at the foot goes on faster than is compensated by the increased velocity of downward motion of the ice; but as the season advances, and the covering of snow is thawed, and the whole length and depth of the glacier feels the softening influence of summer, the increasing rapidity of motion over-compensates the waste. The great moraine of the glacier extends up either side in the usual manner. The blocks are of very beautiful crystalline gneiss.

We returned as we came. I stopped to sketch at the third moraine, or barrier, from the glacier. On reaching Bondhuus, we thought it advisable, after consulting our guide, to prepare for to-morrow's journey across the Folgefond to Odde on the Sör-fiord, by going ourselves overnight to Qevrehuus, at the very top of the Moranger-fiord, where alone good guides can be obtained for crossing the snows, as John Bondhuus himself very candidly told us; and the old man willingly rowed us across in his boat, though he thereby lost our night's custom, which we also regretted, as his beds looked very clean. Our evening row, though short, was very lovely indeed. It was ten o'clock, and I saw stars for the first time in Norway. The evening looked settled, and the effect of fading twilight on the deep fiord was admirable. Bondhuus introduced us at the untimely hour of eleven to a peasant named Swale at Oevrehuus, who, with his wife, immediately rose to receive us, and to make preparations for crossing the *fond* the following morning. The beds, if not luxurious, were clean, and we slept well.

One difficulty connected with travelling in Norway is this, that the great variations in weather, and the frequent necessity of sitting many hours in an open boat, makes it absolutely necessary to carry a large stock of warm clothing, which becomes most burdensome when strictly pedes-

trian excursions intervene. Here there was no help. Our whole luggage must be carried across the snow-field. Our host, with his son and daughter, undertook it. We thought that the girl had more than her share, whilst the boy, who was younger, was rather spared. Swale himself carried a heavy burden, considering the toilsome ascent. They all used a rope, with a wooden runner upon it, such as they employ for collecting and carrying great bundles of hay. As all the arrangements were made with great deliberation and gravity on the part of the family, it was half-past six A.M. before we were ready to start.

The little valley of Oevrehuus, which continues the depression of the Moranger-fiord, is short and steep; but the lower part is remarkably verdant, and beautifully diversified by rock and wood. As we wound with our little train along the steep footpath, amongst the dewy meadows, we met plenty of peasants intent, like those of Bondhuus, on securing their annual harvest of hay. At length the way became very steep indeed, though a kind of track might be traced all the way up to the borders of the snow, which is frequented by the few travellers who pass this way, and by some goatherds who were already before us with their flocks on the hill sides. The chief depression of the valley winds towards the south, but we kept right onwards in a perfectly straight line, east of the hamlet which we had left, which, with the fiord beyond, seemed on looking back still almost under our feet, when we had been laboriously ascending for three hours. We were obliged to march slowly, on account of our heavily-laden attendants, and it was half-past ten when we reached the level of the snow. The aneroid barometer—which I had examined very frequently during the ascent—seemed still to act correctly; and from

its indication I obtained a height of 3700 feet above the hamlet of Oevrehuus, which is but little elevated (perhaps from 100 to 200 feet) above the sea. We rested a good while before entering on the "fond" or snow-field, and our guides dined on their usual homely fare of *flad brod* and butter. We should have done well to follow their example, but I had much under-estimated the extent of our march over the snow, and the inconvenience of halting there. In fact, judging from the map of Munch (and, I believe every other), it would appear as if Odde, on Sör-fiord, whither we were bound, lay precisely opposite to the Moranger-fiord, on the other side of the Folgefond. Had this been the case, we should only have had to cross the "fond" in its narrowest dimension, which is not great; but the case is widely different—the track to be pursued runs parallel to the chain along its highest ridge for a long way. On gaining the top of the acclivity, which we had had in our view from the moment of leaving Oevrehuus, we entered all at once upon the table-land of the Folgefond, one sheet of bright, nearly level snow, which yet did not make itself visible by any overflow on the side by which we had ascended.

I was naturally very curious to examine what I had seen so often described, as these Norwegian plateaux. The snow, fortunately for us, was of very good consistence. Probably new snow does not frequently fall in summer, for the general level is but little above the snow line. It is, for the most part, in the state of *névé*, a term applied to the stratified slightly compressed snow of the higher Alps, before it is condensed into the crystalline ice of glaciers. The stratification here, however, is not *particularly* well marked. This *névé* moulds itself to the greater or less inequalities of the plateau, forming large crevasses

here and there; and the general form of the ground is trough-shaped—the two edges of the *fond* (east and west) being commonly higher than the centre, and the centre or trough inclining gently to the north. We kept the western heights (that is, the side by which we attained the snow), gradually ascending. One of the first objects I saw was a small but true glacier of the second order, reposing on a rock having apparently a very moderate slope near the middle of the *fond*, and connected with one of the higher domes of snow to the N.E. It appeared perfectly normal, with intersecting crevasses (owing to the convexity of the surface on which it moved), somewhat like the dwarf glaciers of the Trélaporte at Chamouni. I think that bare rock, or at least ground where snow melts, may be considered as almost a *sine quâ non* for a true glacier, whilst a *névé* may or may not be so accompanied. Wherever we have this, with a good *feeder* or snow valley, and not too great an elevation, and even a very moderate slope, *there* a glacier forms as a matter of necessity. I afterwards saw many such in connection with the Folgefond.

Our course on the snow being such as I have already described, we had the trough of the *névé* on our left, whilst before us rose low domes of snow, of which, till we successively surmounted them, each appeared to be the last. Such a progress is tedious, though not in the slightest degree difficult in fine weather; but in fog or sleet it must be much otherwise, and in truth such passes are obviously the most dangerous in such circumstances—the monotony of the ground trying severely the intelligence of the guide. As we walked along, I heard the roar of a waterfall, as if from the snowy ravine on our left, and asked with great

surprise if it were possible that a body of water could exist under such circumstances. But in truth it was only the sound of a very distant cataract (probably the Skegedals-foss on the farther side of the Sör-fiord), carried to the ear by a fitful gust of the now rising storm. The highest point we reached is called Folgefonds Oer (or ear). My aneroid barometer had ceased to indicate correctly, owing to a defect of the reacting spring, but, as nearly as I could estimate, our elevation was now 4450 feet above the sea.* The thermometer was 44°; the sky was lowering, but the distance clear towards the Hardanger-field, where the horizon was occupied by many dark and wild mountains, streaked with masses of snow, the relics of the past winter, which yet did not form united snow masses, and consequently had a peculiarly dreary and unpicturesque aspect. We were as yet little more than half-way across the *fond*, and the cravings of hunger in my companion and myself became almost irresistible. Our guides, however, eyeing the coming storm, positively refused to halt in the midst of the waste, and our provisions were packed up in one of the bags which they carried. I suffered simply from hunger; but my companion, less inured to such fatigues, felt his strength giving way, and having exhausted such trifling stimulants as we had about us, his case began to assume an alarming aspect, and his exhaustion and disposition to sleep so great, that I insisted on Swale stopping and unpacking the provisions where we stood. I

* This result is worthy of little confidence; both it and the last-mentioned (3700 feet) are probably somewhat underrated. The snow line, according to Naumann (Reise i. 109), is almost exactly 4000 Rhenish feet (4120 English) on the side of the Sör-fiord; and the highest summit of the "fond" Regnenuten 5220 Rhenish, or about 5380 English feet.

then opened one of Mr. Gillon's excellent cases of preserved meat, which my friend ate with appetite, and an immediate recovery of the energy which was fast subsiding. Rain began to fall before we extricated ourselves thankfully from the snow, and began a rude and fatiguing descent upon the village of Tockheim on the Sör-fiord, but the view was too vertical to be pleasing. When, at last, wet and weary, we reached the outskirts of the little hamlet, a most characteristic scene took place. Our guide, his son, and daughter, deliberately halted by a stream, and proceeded to *perform their toilet*, that they might present themselves with an external appearance befitting their respectability to the strangers or acquaintances of Tockheim. Remonstrance, my companion told me, would be altogether useless, and when gently tried, was rather rudely repelled. These worthy folks, although they unquestionably found our baggage a somewhat oppressive burthen, had loaded themselves besides with various articles of dress which were now put in requisition, and they entered the village with an air certainly very unlike their way-worn appearance a short time previously. We then crossed the head of the Sör-fiord in a boat to the comfortable inn at Odde, or rather Bustetun, for Odde is the name of the church only.

I had intended next morning to make an excursion for a few miles up the valley towards Seljestadt, which is said to be extremely beautiful, and perhaps also to the Buer Glacier, a small outlet of the Folgefond. But the weather appeared so menacing, that, fearful of detention, which would have proved inconvenient, I embarked in a boat, with three men, to descend the Sör-fiord, and regain the main trunk of the Hardanger-fiord, which I had quitted to visit Bond-

huus. The Sör-fiord is nearly straight for a space of about 20 English miles, and being overhung throughout its whole length on the south-western side by the steep mountain of the Folgefond rising nearly unbroken from the water's edge, it has a severe, almost gloomy, and perhaps monotonous aspect. But weather, struggling between wet and dry, with rolling mists on the hill tops, is not favourable for such scenes as these. The Folgefond was, however, clear, and I carefully examined the aspect of the snow and ice when it appeared. This occurs wherever a valley or well-marked ravine runs up from the sea, and there a tendency to form a true glacier is always observable. The largest I noticed was near the hamlet of Moge (so marked on Munch's map); it has a large stream issuing from it, but the glacier terminates at a great height, for the tendency of the "field" to form longitudinal valleys, as already stated, is unfavourable to the existence of snow basins or feeders.

Ullensvang, one of the best known spots in the west of Norway, is a village and church most beautifully situated on the eastern bank of the Sör-fiord. It lies at the opening of a richly-wooded valley, traversed by a considerable stream, which forms a picturesque waterfall in the background of the landscape, seen from the fiord. The scenery recalls that of the Lake of Thun, in Switzerland. The church and parsonage, charmingly situated amongst fruit and other trees close to the strand, was long the residence of Mr. Herzberg, universally known in Norway as one of the most benevolent and best informed of the clergy; but he has been for some time dead. The distance from Odde to Ullensvang is reckoned at two Norwegian miles, and to Utne, at the opening of the Sör-fiord, one mile farther. But

it cost us 7½ hours of most patient and laborious rowing; consequently the distances are certainly much under-rated, although payment is made strictly according to the distances thus counted. Utne is an excellent country inn, and would be a desirable centre for excursions on every part of the Hardanger-fiord and its branches. Even the Vöring-foss (a celebrated waterfall) may, it is stated, be visited in a long day, including the return; and the view from the Oxebierg, a mountain on the opposite (north) side of the fiord, must evidently be very fine, and the ascent is said to be easy.

From Utne we proceeded next morning across the Hardanger-fiord to Graven, or rather Eide (where we landed), on the way to Voss. This road offers a considerable variety of scenery, and, though on no very great scale, is highly characteristic of the Norwegian landscape. Several picturesque waterfalls occurred, adorned with hanging wood, and a pretty lake, half a Norsk mile in length, forms part of the *highway*, there being no road along its bank. Near Vossevangen the country is in some places densely wooded with pine, fir, and birch, which are exported in considerable quantity; in some places it has an open moorland character. The approach to Vossevangen is striking. It is an important place, forming the centre of a large district, whose inhabitants have a character of their own different from those of the Hardanger on the one side, and the Sogne-fiord on the other, and less amiable than either. I had been recommended to try Voss, as a better climate than Bergen for seeing the eclipse, but it appeared that I should not have gained much. The inn at Vossevangen was not so good as its important position led me to expect, and the neighbourhood

was also less picturesque than it had been represented to me. It being of great importance to me to gain a day, I resolved to proceed in the afternoon two stages towards Gudvangen, to Vinje, although assured that it was next to impossible to sleep there.



THE FJÆRLANDS-FIORD.

CHAPTER VII.

THE SOGNE-FIORD.

VINJE TO GUDVANGEN—THE NÆRŒ-FIORD—SINGULAR AND WILD SCENERY—LEKANGER THE SYSTRAND—FJÆRLANDS-FIORD AND ITS GLACIERS — REACH STÖLUM—THE SUPHELLE GLACIER DESCRIBED—ITS REMARKABLY LOW LEVEL—RETURN TO LEKANGER—STANDING STONES OF NARGLA—SOGNDAL—ANCIENT MORAINE—GEOLOGY AND FINE SCENERY—SOLVORN ON THE LYSTER-FIORD—RÖNNEID—ARRIVE AT JUSTEDAL.

We were now on the highway from Bergen to Christiania. The drive from Vossevangen to Vinje was increasingly beautiful. At first we followed the base of extremely bare, bleak hills, part of the chain between Vossevangen and Bergen, on which the snow lay in great patches in the beginning of August, at what seemed to me a very low level.

At Tvinde, the first stage, is a very fine waterfall, and from hence to Vinje the scenery was really most beautiful—a mixture of verdure, forest, rushing water, occasional cultivation, and hills of striking form in the background. It reminded me of some of the best scenery of Cumberland and Westmorland. It was unfortunately dusk when we reached Vinje, and, notwithstanding most unpromising accommodation, we managed to sleep well, and proceeded next morning to Gudvangen, two stages, the scenery of which is justly regarded as amongst the finest in Norway. Indeed I had heard so much of it, that I ran no small risk of disappointment. The ascent had been nearly constant from Vossevangen to Vinje, and the next two stages were therefore on a decline, as the level of the sea was to be again reached at Gudvangen. We came upon a new and beautifully constructed road on the banks of a small lake, not far from our night quarters, from whence a striking descent, amidst woods and ravines, commences, abounding in points of view of the highest picturesque, enhanced to the eye of the geologist by crystalline rocks of exquisite beauty through which the new road makes advantageous sections. They belong to what has been called by Esmark the *norit* formation, evidently subordinate to gneiss, but in which the felspar is pure white, interspersed with quartz and with fine green hornblende, and masses of crystalline garnet of a rich orange colour, forming a combination remarkably striking. Naumann and others have sketched the geology of this singular region, but it would probably well repay a detailed examination, and suites of specimens of the utmost beauty might be obtained with a little patience.

At Stalheim, the next post, the scene becomes wilder.

We are at the head of the Nærœdal, one of those singular clefts common in Norway, bounded on either side by cliffs, usually perpendicular, to a height of perhaps 1500 or even 2000 feet; the bottom flat and alluvial, and terminating abruptly at the head by a steep, but not precipitous slope. Down this slope the road is conducted by a series of zigzags, or rather coils, in a masterly manner, through a vertical height of 800 feet—a very striking waterfall rushing down on either hand, and rendering the view in the opposite direction (towards Stalheim from below) wonderfully grand. It is generally agreed that no more genuine specimen exists of Norwegian scenery than the Nærœdal. From the foot of the descent to Gudvangen, on the banks of the Nærœ-fiord, the road is nearly level—the whole descent on several miles being little more than 300 feet. The mountains, however, preserve all their absolute elevation on either side, so that the ravine, though not quite so narrow, is deeper. The masses of rock on the right rise to 5000 or 6000 feet, and a thread of water, forming the Keel-foss, descends a precipice estimated at 2000 feet.*

The arrival at Gudvangen takes one by surprise. The walls of the ravine are uninterrupted; only the alluvial flat gives place to the unruffled and nearly fresh waters of this arm of the sea, which reaches the door of the inn. After dining and procuring a boat and three excellent rowers, we proceeded to the navigation of the extensive Sogne-fiord, of which the Nærœ-fiord, on which we now were, is one of the many intricate ramifications. The weather, which had fortunately cleared up for a time, was now again menacing, and a slight rain had set in when we embarked. The

* See Murray's Handbook, and Forrester's Norway, where a good view of the scene is given.

clouds continued to descend, and settled at length on the summits of the unscaleable precipices which for many miles bound this most desolate and even terrific scene. I do not know what accidental circumstances may have contributed to the impression, but I have seldom felt the sense of solitude and isolation so overwhelming. My companion had fallen into a deep sleep; the air was still damp and calm; the oars plashed, with a slow measure, into the deep black fathomless abyss of water below, which was bounded on either side by absolute walls of rock, without, in general, the smallest slope of debris at the foot, or space enough anywhere for a goat to stand; and whose tops, high as they indeed are, seemed higher by being lost in clouds which formed, as it were, a level roof over us, corresponding to the watery floor beneath. Thus shut in above, below, and on either hand, we rowed on amidst the increasing gloom and thickening rain, till it was a relief when we entered on the wider, though still gloomy, Aurlands-fiord, in which the sea had a more natural and agitated appearance. It is strange to think that the navigation I am describing is part of the regular journey betwixt Bergen and Christiania. For ten or twelve hours, and in bad weather far more, the traveller is condemned to the exposure and risk of an open boat, along the precipitous and inhospitable shores of the Sogne-fiord, before he regains the high road at Lærdalsœren. For all this way, neither shelter nor accommodation is provided.

Our route, however, was not directed to Lærdal. With a view to the main object of my journey, I was first to explore the glaciers of Fjærland and Justedal. The former are on an unfrequented fiord, branching off from the Sogne nearer the sea than Aurlands-fiord. We were to

sleep at Lekanger, a water station on the north side of the Sogne-fiord, in that part of it called the Systrand. Passing Fresvig on the left, we had a glimpse of green fields, and cultivation, and wood, which cheered the eye after the wilderness we had quitted. . It is stated by Vargas Bedemar,* that near Fresvig is a glacier which I have not seen mentioned elsewhere. The weather brightened, and our spirits rose as we approached Systrand, and, with the most agreeable surprise, I found a thriving cheerful hamlet, and one of the best inns I had met with in Norway. I had also letters to two official gentlemen, from one of whom, in particular, I received the most polite and cordial attentions. I regretted here, as elsewhere, that the unstinting hospitality which introductions everywhere procure in Norway, could not be enjoyed by me without sacrificing the great objects of my tour; and, in his anxiety to advance, a traveller ever runs the risk of seeming to undervalue the efforts made to induce him to find a home and resting-place at every house where he is entertained by those to whom such a concentration of purpose appears unnatural, and such haste unnecessary. It was with great reluctance, therefore, that I had to entreat my kind entertainers, as the best proof of friendship, to find the means of forwarding me surely and expeditiously to Fjærland.

Next morning at eight o'clock we were on board a private boat, with three capital rowers, on our way to Fjærland. The weather was rather fine than otherwise, and, as we pulled against the wind, and close in-shore (which, as I have already observed, is the invariable practice of the Norwegian boatmen), we had an opportunity of admiring the great beauty, and, what in any country

* Reise i. 203.

might justly be called, the luxuriance, of the Systrand. For a space of two miles or more, which separates the church of Lekanger from the inn, we passed a series of cheerful habitations, interspersed with orchards which are celebrated, and in the garden of the parsonage are oak and walnut trees of remarkable beauty. We had already observed, not far from Lekanger, corn crops quite yellow, and seemingly almost ripe, in utter contrast to the raw green of the scanty corn-fields of Bergen and Voss. Indeed, it is certain, though remarkable, that the interior of the Sogne-fiord—in the immediate neighbourhood of the highest ground in Norway, and of its most extensive snow-fields—is, in point of climate, far superior to the coast with its incessant rain. Near the church of Lekanger we also observed a rude slender obelisk, of a single stone (said to be 28 feet high). Such monuments are not unfrequent here. They are called "bauta" stones, and were probably erected at the places where the courts of justice (*Things*) were formerly held. They occasionally are covered with Runic characters, but not, I believe, in this instance. At Lekanger and in its neighbourhood I observed well-marked terraces parallel to the beach. One of these, I conjectured (but by mere guess) might be at a height of 120 feet. Traces of such terraces are to be found in almost every inlet of the Sogne-fiord which I have visited.

After rather a heavy pull against the breeze, we reached the entrance of Fjærlands-fiord. Balholmen, on the west shore, has some population, but in general the coasts of this remote inlet are scarcely inhabited, being steep and rocky—not, however, for the most part precipitous—with a good deal of wood, entirely birch and alder. At the entrance of the fiord is a salmon-fishing station, such as I

have described on the Hardanger-fiord, and here and there a few small huts are scattered on the heights. The fiord is long and straggling, but of no great width. The water is nearly fresh as in the other deep inlets of this coast, and is consequently frozen over during winter, so as to be traversed in all directions. This is also the case, more or less, in the other landward fiords. There appears to be a small but regular tide, and sea-weed grows up to the very head of the creeks, though the water is so fresh that it may be drank without inconvenience. I was curious to know how the uniform ice (over which the winter traffic is performed) could be maintained in a tidal channel; but I learned that the ice is always more or less detached from the shore, and therefore floats up and down with the tide.

As we neared the head of the fiord, snowy mountains and glaciers came into view. These all form part of the great snow-bearing range of Justedals Bræen, which runs parallel to the Sogne-fiord for a great distance, and divides it from the district of Nord-fiord. Into this compact mass of mountains on its southern side (as will be seen by the map) the Fjærlands-fiord makes a profound indentation. The valley of Mundal, which opened on our left, showed some small glaciers, and the main head of the fiord divides into two valleys, the left or westernmost of which terminates in the great glacier of Boium, of which the upper part is well seen from the fiord, descending from the "fond" of Justedals Bræen above; and also contains a smaller glacier, terminating at a high level. The other, or eastern valley, contains the Suphelle Brae or Glacier, remarkable as being the nearest to the sea-level of any in Norway Proper, and indeed, I believe, of any in Scandinavia, with the sole exception of the glacier of the Jökuls-fiord in Finmarken. It was on this account

that I had made no slight exertion to reach this spot, which has been visited by, I believe, a very few Norwegian tourists, and perhaps a German artist or two. The lower part of the Suphelle Brae can be distinctly seen from the fiord. I made a sketch of both valleys in my pocket-book, which forms the vignette at the head of this chapter; but, though correct individually, they cannot be simultaneously seen within the horizontal range there represented.*

We reached Stölum, a hamlet at the highest navigable point of the fiord, which was to be our quarter for the night, at three P.M., or seven hours from Lekanger, and having ascertained that we could be lodged at the house of a man named Iver, we proceeded at once to visit the Suphelle Brae. The distance was greater than I had been led to expect, being considerably above an hour's walk to the ice, and everything was drenched by a slight drizzling rain. The glacier, however, was quite clear. I sketched it from the small hamlet of Suphellen, as seen in Plate VII. From hence, as from the sea, the glacier *appears* as if in complete continuity with the great snow-field above. It was not until (as is my custom) I had mounted some way over the ice itself, that I discovered, to my surprise, that a very lofty cliff of rock entirely separates the upper from the lower glacier, the latter being in fact what is termed by the later Swiss writers a *glacier rémanié*, formed altogether of icy fragments precipitated by avalanches from the steep and pinnacled glacier above. It is an exceedingly remarkable

* The artist has failed in expressing correctly the left hand part of the scene. The glacier of Boium, at the head of the valley in that portion of the figure, is obscurely shown, and what appears as the sky line is, in point of fact, the lower limit of snow and ice-fields, whose tops were concealed by mists.



James D. Forbes del. — Hache lith.

Day & Son, Lith.rs to the Queen.

SUPHELLE GLACIER, FJÆRLAND.

arrangement, which has no parallel in the greatness of its scale in the Alps; but it recalls the small *glacier rémanié*, which is imposed upon the glacier of La Brenva.* Indeed, we have only to suppose the declivity down which that glacier descends from Mont Blanc to be somewhat greater than it is, in order to cause a complete instead of a partial separation (for there is an island of rock in the centre of it, traversed by avalanches) of the lower from the upper ice. Like the small superimposed glacier of La Brenva, the Suphelle Brae presents a distinct, though far from delicate veined structure everywhere near the contact with the surface on which it rests, after the type of ordinary glaciers. The upper part of compact whitish ice (like the glacier of Bossons) is nearly amorphous. It is dangerous to ascend too high, on account of the frequent ice-falls from above. I was unable to ascertain clearly whether the upper and lower glacier unite in winter. I heard a rumour to that effect, but I scarcely think it likely.

This glacier does not occupy the *head* of the valley in which it occurs, but pours down into it laterally over the precipice already mentioned. My guide stated that, 100 years since, it was much larger, so as to extend quite across the valley, thus damming up the river which runs through the latter, or possibly letting it pass beneath the glacier, as at La Brenva. A large block of stone was pointed out to me in evidence of the fact. This tradition corresponds with the known increase of size of the Justedal glaciers about the same period. A series of *moraines* mark the successive retrogradations of the ice. They are principally composed of gneiss. By the aneroid barometer, I estimated the lowest part of the Suphelle glacier at only *one hundred and*

* Travels in the Alps, chapter 10.

five feet above the level of the sea, the bottom of the valley rising almost imperceptibly.

I had heard from several quarters that there is a pass over the snow, from the head of the valley of Suphellen, across an isthmus of the great Justedal snow field, to the head of the valley of Sogndal (which I afterwards reached by a very circuitous sea voyage). This was substantiated afterwards by a gentleman of the highest respectability, whom I met at Solvorn, and who had made the passage, but in the opposite direction, *i. e.*, from Sogndal to Suphellen. He described it as requiring not more than six or eight hours, and as unattended with much difficulty or danger, excepting only the descent into the valley of Suphellen, which has to be made down a steep *couloir* of snow. This, as alpine travellers well know, is one of the most real dangers of snowy regions, and one which, more than almost any other, is trying to the nerve of the mountaineer. As the ascent, in such cases, is incomparably easier than the descent, the passage ought to be attempted from Suphellen to Sogndal.

Having satisfied my curiosity with regard to the glacier of Suphellen, I returned by the same way. But when I reached the place where the two valleys of Boium and Suphellen divide, it was too late to think of visiting the glacier in the former, which the guide told me cannot even be seen distinctly, until several English miles have been traversed. I therefore returned to Stölum, where my friend and I slept in the house of Iver, in rather a primitive fashion, but soundly.

The next morning I had to decide whether to visit the Boium's Brae or not. A damp drizzle made me decide in the negative, and we returned in our boat to Lekanger,

where, after hospitable entertainment by the friends to whom we had been introduced, we again took boat for Sogndal. Notwithstanding the threatening appearance of the morning, the day had cleared up beautifully, and now we had again really fine weather, which, in a boating expedition, is inexpressibly cheering. The barometer, which in Norway moves with a suddenness which takes one by surprise, rapidly rose three quarters of an inch. Having a favourable breeze part of the way, we performed the voyage from Fjærland to Lekanger in six and a half hours. The distance to Sogndal from Lekanger is called only one and a half Norsk miles, but it took us three and a half hours, though we made sail part of the way. After again admiring the cultivated and well-wooded shores of the Systrand, we sailed under exceedingly bold precipices, with here and there ledges of verdure, which we were told are reached from above, and regularly cut for hay. A pathway also exists all along the apparently inaccessible face. We then turn abruptly into the Sogndals-fiord, which runs N.N.E. off the Sogne-fiord, and is certainly one of the most pleasing, in point of scenery, which I have met with in Norway. We landed at a sort of isthmus on the west shore, and traversed it on foot, sending the boat round. We thus had the opportunity of seeing three standing stones, or bauta stones, near the village of Nargla Tune, the inhabitants of which came out to look at us whilst I made a slight sketch of the stones, with the beautiful expanse of the Sogndals-fiord beyond. I may mention in passing that the word *Tune*, for a small collection of houses, such for instance as the dependencies on a single farm, is evidently the original of the Scottish word *Toon* similarly employed. We were here offered

cherries nearly ripe. The fiord was pleasingly wooded, chiefly with deciduous trees; but farther up forests of pine extend a long way to the eastward, and timber is a considerable object of exportation. Few villages in any country are more pleasingly situated than Sogndal. Judging from the map, I fancied it situated in a rent of the mountains like the sombre crevasse of Gudvang. On the contrary, I found verdure, cultivation, and undulating hills, mingled with rocks and wood. The interior of the village scarcely corresponded to its general aspect, but the inn proved good.



SOGNDALS-FIORD FROM NARGLA TUNE.

Our object was now to proceed to Justedal and its glaciers, and for this purpose we were to rejoin the Sogne-fiord at its highest branch, which is termed Lyster-fiord, and for reasons of convenience we resolved to do so at Solvorn, though a little out of the direct course, as I had been recommended to a gentleman there from whom I might expect useful advice. As we were told that the road to Solvorn was good, we ordered, as usual, a car to hold two, but we were provided only with a common cart for

holding luggage (as every one rides on horseback here), and eventually walked nearly the whole way. We thus lost something in time, but gained in enjoyment of the scenery, which is in the highest degree charming, Swiss in character, but on a comparatively small scale. We first followed the fiord up to its head at Aaren, and had hardly left Sogndal when I was struck by what appeared to be evidently a *moraine*, composed of blocks of a granitic rock, greatly resembling at first sight the protogines of the Alps, although it contains mica. This rock is most widely distributed in blocks over the whole of this country. From their extreme abundance in this valley, and also at Solvorn, where I collected some of the best specimens, I am satisfied that they have their origin in the neighbouring range of the Justedals Bræen, and have been transported by the glaciers which still occur on a small scale at the head of these valleys. It is without exception the most beautiful Norwegian rock which I have seen. Its general hue is red, which arises from the felspar, of which the concretions approach to lenticular forms; there is quartz, and a little black mica; but with these ingredients is a fourth, of a pale and pleasing green colour, somewhat resembling chlorite, but harder. I presume that the source must be an abundant one, or perhaps there are several; for I have traced blocks closely resembling these not only to Maristuen on the Fille-field, and even to Vang on the Little Miösen lake, not less than fifty English miles in a straight line. At Aaren we quit the fiord and follow the bank of a fine rushing stream which has its origin in the Veitestrandsvand or lake, which penetrates far into the mass of the Justedal mountains, and has, according to Munch's map, a glacier at its head. It is evi-

dently from hence that the granite just described has been so extensively spread abroad. Quitting the bank of the river, we ascend a series of zigzags on the right, now a skilfully conducted carriage-road, but formerly almost impassable. Here we have crags mixed with wood, and enormous blocks of granite piled one on the other,* the whole in the style of one of the lower Alpine passes, such as the Brunig, and exceedingly beautiful. It terminates in a fir wood, whence we emerge on the cultivated upland of Hafslo—a populous parish, including a lake, on the further side of which stands the church. Finally, we had a rapid and picturesque descent upon the very pleasing village of Solvorn, charmingly situated amongst corn-fields and orchards on the Lysterfiord, and overhung towards the north by a vast rocky promontory with precipitous faces, extending for a mile or two its inaccessible cliffs into the fiord. These cliffs (it may be mentioned in passing) showed traces of an enormous avalanche or detachment of a rocky mass from its face which lay in fragments at its foot. The frequency of such recent and enormous falls of rock in Norway is very striking as compared with any other country which I have visited. The precipitousness of the mountains, the abundant moisture, and frequent congelations are, no doubt, the leading causes.

At Solvorn I obtained information about the valley of Justedal, and through the kind assistance of a friendly official, dispatched my *forbud* papers for my journey to Christiania the ensuing week. We then took boat to Rönneid (1⅛ Norwegian miles) where we are at the entrance of Justedal, and intended to proceed directly to the præsten-

* The blocks are of the red granite previously described. The crags are of grey granite with a distinct cleavage like the protogine of St. Gothard.

gaard or parsonage for the night. The banks of the Lyster-fiord are well cultivated wherever the precipices allow it. In some instances farms are visible at a great height above the sea-level. Captain Munthe's house at Kroken is beautifully situated amidst abundant wood and now yellow corn. Fruit trees, I believe, abound even up to the highest creek of the Sogne-fiord in this direction, although but little distant from the Horungerne, almost the highest range in Scandinavia.* As we approached Rönneid, we saw at a distance behind us, on the opposite side of the fiord, the imposing waterfall of Feigum-foss. At the very moment of our arrival, we observed a cavalcade of five persons, already mounted, and starting in the direction of Justedal. Two of them were English gentlemen whom I had previously met at Christiania, and who told me that they had seen the total eclipse well at Lærdalsören. I perceived the impossibility of intruding seven persons at once on the hospitality of the clergyman at the late hour at which we must necessarily arrive, and, with some regret, I determined to spend the afternoon at Rönneid. This proved to me very nearly the loss of a whole day, for which I should have had ample employment amongst the glaciers of Justedal; but it could hardly be avoided. I forwarded my letter of introduction, and mentioned that I should go on from the parsonage next day, and sleep at the châlets farther up the valley. At Rönneid

* Until comparatively lately, Sneehättan was considered the highest hill in Norway (7300 Nor. feet). Keilhau, I believe, first showed that the summits of the Horungerne, and especially the Skagtolstind, approached 8000. It is now estimated at 7800 (=8000 Eng.) But the Ymes-field, which lies farther east, is now considered the highest, and to be about 8200 Norsk, or 8400 English feet. These are, however, only estimations, and are not always uniformly reported. I have taken Munch's Statement (*Gæa Norvegica*, p. 514).

we found a good clean inn, but expensive for Norway. My evening ramble in the neighbourhood did not show much new. Granite is everywhere abundant—the rocks are all *moutonnées*, especially in the trough of the valley—some fine polished and striated examples occur close to the pathway and the river. They are often surmounted by transported blocks, also of granite, rounded at the edges.

The following morning we started on horseback for Justedal. The weather was superb and the beauty of the ride far surpassed my expectations. It is one of the few Norwegian valleys which I have seen really comparable to those of Switzerland. Though only a bridle-road it is carefully made in all dangerous places and follows throughout nearly the course of the river Storelv, a fine torrent, but the track at times ascends to a considerable height and commands imposing views. The valley is everywhere interspersed with wood, and there are several farms passed, and good pasturages. The rocks are generally of granite, sometimes covered by gneiss, even approaching to mica slate. The granite sometimes becomes very compact, passing into a kind of porphyry. Distinct marks of glacial action are very general. The weather was very lovely, and towards noon became almost insupportably hot—the sun being nearly as piercing as I ever felt it in the valleys of the Alps.

After four and a half hours of moderate riding we arrived at the parsonage of Justedal. We came upon it abruptly, having just traversed a picturesque pine wood, and looked down upon the church and minister's house lying in a confined hollow below us. Yet it is by no means the most attractive spot in the valley. The church is built entirely of wood, and tarred; it is in very bad repair, admitting the

weather in many places, and the snow in winter. Owing to the defective and peculiar state of the law in this respect, it is nearly impossible to get the necessary repairs made; the churches being generally private property, and a certain income is derived from the use of them. The præsten-gaard or parsonage is a comfortable house, and we experienced a most friendly reception. But the increasing numbers of travellers who annually pour into Norway (especially English), make the duties of hospitality somewhat severe in this remote valley, where it is next to impossible to find any other accommodation; and the living is unfortunately one of the poorest in Norway. Its elevation above the sea is 460 English feet according to my observations (mean of two, going and returning), which is considerably less than it has usually been reckoned.

CHAPTER VIII.

JUSTEDAL — THE FILLEFIELD.

THE KRONDAL—GLACIER OF BERSET—ITS VEINED STRUCTURE—DIRT-BANDS—AND PROBABLE ANNUAL PROGRESS—ITS MORAINES—MODERN DECREASE OF THE GLACIERS OF JUSTEDAL—LEAVE THE KRONDAL—REMARKABLE ROCHES MOUTONNÉES—NYGAARD GLACIER—ITS POSITION AND SIZE—ITS STRUCTURE—COMPARED TO THE SWISS GLACIERS—ITS ANCIENT MORAINES—RETURN TO SOLVORN—SCENERY OF THE SOGNE-FIORD TO LÆRDALSÖREN—CARRIOLE JOURNEY TO CHRISTIANIA—FARTHER REMARKS ON TRAVELLING IN NORWAY—CHURCH AT BORGUND—THE FILLEFIELD—LITTLE MIÖSEN LAKE—ARRIVE AT CHRISTIANIA—RETURN TO ENGLAND.

HAVING spent the mid-day hours of intense heat in repose, we proceeded on horseback to the glaciers which all lie further up the valley. They all descend from the range of Justedals Bræen on the west or left slope. The first occupies the head of the Krondal, and is sometimes called the glacier of Berset. The next is the Nygaard Glacier which descends nearly to the main valley of the Storelv. Some miles higher up, opposite the châlets of Stordal, is the Biörnestegs-brae* (Bear's path glacier), and still higher up, near the origin of the valley, the Lodals and Trangedals glaciers. By the former of these two, the summit of the Lodals-kaabe, or mantel of Lodal, is reached. This latter is an excrescence from the general plateau of Justedals Bræen, surpassing it by less than 2000

* The Faabergstol glacier of Durocher.

feet.* These glaciers are all partially or fully described by Bohr† and Naumann in his Norwegian journey; but the best account is by M. Durocher, in a highly interesting paper in the *Annales des Mines*,‡ in which he has clearly expounded and ably maintained the viscous theory of glaciers. My observations include only the first two of the glaciers already named.

Mr. Heltberg assured me that it was quite impossible to pass the night with the least comfort at the hamlet of Elvekroken, just below the larger or Nygaard glacier, and ad-

* The highest part of Lodals-kaabe is 6400 Rhenish (= 6600 English) above the sea.

† Edin. New Phil. Journal, vol. iii. 1827.

‡ *Quatrième Serie*, tom. xii. p. 3, (1847). The glacier of Lodal, the largest of the group, is thus described:—"The third branch of the Stordal is the least inclined; it is filled by the magnificent glacier of Lodal, which follows at first a S.E. and N.W. direction, and faces the S.E. It is the largest of Scandinavian glaciers; it may be compared to that of the Aar in the Alps, which it resembles in several of its characters. At its extremity it is in great part covered by large blocks, by gravel, and fragments of different sizes; its medial moraine is there considerably widened, and has united itself with the lateral moraine of the left bank. The ice is only displayed in the small space separating the medial moraine and that of the right bank." The slope of the glacier, which is 6° or 7° near its extremity, diminishes to only 3°, forming a singularly level and united glacier for a distance of 5 kilometres (about three miles). It there bifurcates, one branch being almost precipitous. The level branch subdivides again higher up near the commencement of the *névé*, and both the tributaries become rather steep and traversed by transverse fissures. By one of these, the *plateau* of Justedals Bræen may be gained, and traversed in the direction of Nord-fiord. By the other the Lodals-kaabe may be ascended, or at least the summit of it nearly approached. The glacier of Trangedal appears to be inaccessible, but the surface is nearly clear of stones. The glacier of Faaberg has a fine vault like that of the Arveron. M. Durocher farther recognises the occurrence of the veined structure of the ice, of glacier tables, and gravel cones, as on the larger and more level Swiss glaciers.

vised my sleeping in a respectable peasant's house in the Krondal, and visiting that glacier in the first instance. This we resolved to do, and departed from the parsonage when the afternoon was already well advanced, but were not a little exhausted by the heat of the day when we reached the hamlet of Krone in the lateral valley of the same name, after about one and a-half hour's ride. The Krondal divides from the main valley of Justedal, and is entered by a pass of a striking character amongst intensely abraded and grooved rocks, picturesquely interspersed with pine wood; the bridle-way follows the course of a roaring torrent. The pines cease immediately after, the Krondal being only wooded by birch and alder. On arriving at Lars Krone's house (to which we had been recommended,) we found accommodation very superior to that of a few nights before at Fjærland. The common room, which serves for sitting-room, kitchen, and family bed-room, was certainly not very clean, yet had the elements of comfort; but in a chamber up stairs we obtained two clean beds with snow-white bed linen, and plenty of milk, flad-brod, and "gammel ost," or old cheese, which is generally used as a delicacy in Norway. I had hoped to visit the glacier the same evening, but found its distance from our abode much greater (as usual) than I had been led to expect. I obtained, however, a distant view by clambering up the wooded slope of the valley to a considerable height, which determined me to visit and inspect it next morning.

The main glacier of Krondal descends from the snow plains of Justedals Bræen in a magnificent sheet, remarkably uniform, yet very steep. It is of course much crevassed; yet I have seldom seen so abrupt an ice-fall so unbroken in its character. When it reaches the valley

it compacts itself, and then commence a series of *waves* and *dirt bands* in the ice, near twenty in number, which I saw beautifully by the evening light, and at a distance of several miles. It may be proper to mention that by *waves* or *wrinkles* we mean alternate ridges and furrows in the ice, on a very large scale, and approximately transverse to the glacier, or running from side to side, but more forward in the centre than at the side, so that their ground plan is concave to the origin of the glacier: by *dirt bands* we denote bands of cellular or friable ice, in which mud and stony fragments find a lodging, and thus faintly discolour the surface of the glacier in the same wave-like forms as the ridges and furrows just mentioned, with which they are so far identical that they are found constantly together; so that the "wrinkles" are visible at a distance, mainly by the discoloration which the "dirt bands" occasion. Accordingly, the latter were first observed by me at Chamouni in 1842, the former in the following year.* I am not prepared to affirm that the explanation of this curious phenomenon is clearly made out; but I have elsewhere endeavoured to show that it certainly depends upon the laws of motion of the glacier, and on the peculiar consistency of the ice of which glaciers are composed. It is pleasing to find features long overlooked, yet apparently essential characters of a true glacier, recognized in regions so remote as Switzerland and Norway, and even in the gigantic mountain chains of northern India. An example has just come under my notice. Dr. Thomas Thomson, in his work on "Western Himalaya and Thibet," page 137, thus describes what he saw on a glacier near the Parang Pass, in lat. $32\frac{1}{2}°$:—"Little rills of water were, at the time we passed, trickling from every part of the surface,

* See Travels in the Alps of Savoy, 2d Edit. pp. 162 and 167, note.

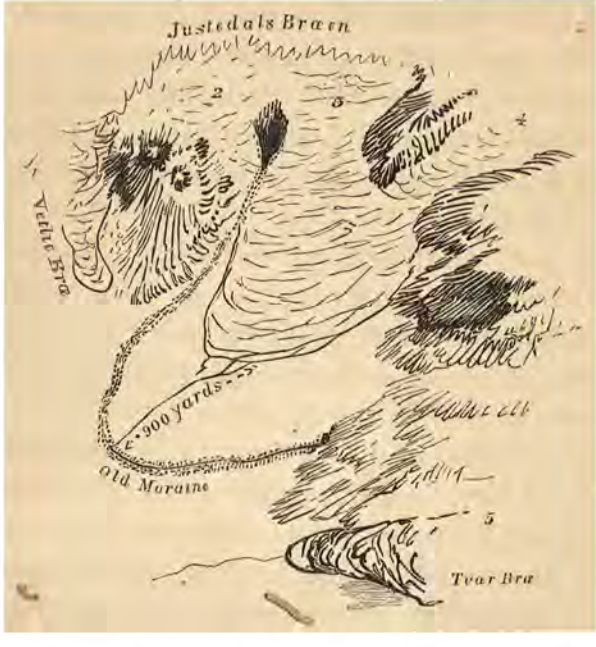
and a small streamlet ran along the edge of the glacier under an arch of ice. The structure here was very evident —broad white bands and narrower ones of a dirty colour from the earthy matter which they had absorbed, ran parallel to the slope of the ravine, the arches or loops being drawn out to a great length." It will be easily understood, therefore, that I was impatient to examine closely a phenomenon of so much importance in identifying the Norwegian glaciers with those of the Alps.

Early next morning I proceeded on foot towards the glacier. The way lay through grass fields or meadows, usually more or less saturated with wet. We passed several clusters of houses or homesteads, and the scale of the scenery was proved by the long time it took us to gain the immediate environs of the glaciers. The head of the Krondal is closed by a perfect barrier of ice, the main glacier being formed by the union of three ice streams descending from the "fond" above.* Two smaller independent glaciers also fall into the valley—the Vetlie Bræ on the left and the Tvær Bræ on the right, as shown in the sketch on the opposite page. About 900 yards in advance of the glacier is a great moraine, evidently modern. Its limits may be at once traced all round, for no birch wood grows within them. Beyond a question, it is of the same date with the great extension of the Nygaard glacier, presently to be mentioned, and of which the date is known. The Tvær Bræ has a corresponding moraine. These ridge-like accumulations are called by the peasants Bræ-vor, "vor" meaning an artificial heap.

The ascent upon the ice of the glacier is exceedingly

* It is also called the glacier of Berset from the name of the highest farm in the valley.

easy; and I found the veined or slaty structure, universally found in the Swiss glaciers, to be developed here in the same manner and similarly disposed with reference to the shape



of the glacier as I have detailed elsewhere in describing these. The crevasses are few, chiefly towards the centre of the ice, and radiating in the lower part, as in Fig. 2, page 172 of my Travels in the Alps. The whole indicates a condition of great pressure from above, derived from the consolidation of the icefall already mentioned, the bottom or sole of the valley being comparatively flat. I estimated (by the aneroid barometer) the foot of the glacier to be 857 feet above the church of Justedal, or 1317 above the sea. * I traversed the ice nearly along the axis or medial line of the glacier until the slope became abrupt, and found

* Lars Krone's house, where I slept, was 667 feet above Justedal parson-

the absolute height to be 2137 feet. The slope in the middle region of the glacier is $7\frac{1}{2}°$; and I had little difficulty throughout the greater part of its length in noting the alternations of compact and veined ice which give rise to the "dirt-bands" so distinctly seen from a distance the previous evening. I took the opportunity of roughly measuring the intervals of those bands by the help of a long staff which I carried in my hand. They were, as I have elsewhere found, somewhat unequal; but an average of 167.7 feet, represents, I have no doubt, very nearly the average annual movement of the glacier. It is an interesting thing to be able to obtain thus, by a single observation, a result which would formerly have required nice precautions and a visit to the same glacier in two or more years.

The morning was intensely warm. It took me five hours to walk to the glacier, visit it, and return to Krone. I then remounted my horse, and reached the Nygaard glacier, or rather the part of the road opposite to, and commanding a full view of it, in about an hour. We had first of course to retrace our steps into the principal valley of Justedal, and then ascend it towards its origin. The road is picturesque, and traverses rocks more completely shaven and abraded than I have almost anywhere else seen. The

age, or 1127 above the sea. The following are the barometrical observations referred to in the text:—

				Det. Ther.		Hourly Var.
Aug. 7.—Justedal Præste-gaard,	11	A.M.	29.245	65°.5	A.	.014
" "	$4\frac{1}{2}$	P.M.	29.17	64.	B.	
8. " "	$8\frac{1}{2}$	P.M.	28.91	57.	C.	.009
9. " "	9	A.M.	28.90	65.	D.	insensible.
Aug. 7.—Lars Krone's house,	$6\frac{1}{2}$	P.M.	28.45	58.	E.	.0075.
8. "	7	A.M.	28.36		F.	
" Foot of glacier,	9	A.M.	28.145	56.	G.	
" " Icefall,	$9\frac{3}{4}$	A.M.	27.32	50.	H.	
" Nygaard gl. lowest part,	$3\frac{1}{2}$	P.M.	28.58	56.	I.	



James D. Forbes del. C. Haghe lith.

Day & Son, Lith.rs to the Queen.

NYGAARD GLACIER, JUSTEDAL.

rock, which is still of gneiss, presents everywhere smooth and rounded summits, as conspicuous as those of the Höllenplatte, near the Handeck, in the canton of Berne, and not less dangerous to the traveller on horseback. It is impossible to avoid them, and the steep and polished sides of these bosses often present no hold to the foot or shoe of the horse. They are besides striated, as usual, in the direction of the valley. It is a strong presumption (as I have already remarked in speaking of the Moranger-fiord) that glaciers caused these peculiar forms, that we invariably find them increase in perfection and freshness as we approach the seat of existing glaciers, and especially in a locality like this, exposed to the inroads of ice at once from several quarters. Pines are sparingly interspersed amongst the *roches moutonnées*, but cease as we open the lateral valley, almost entirely filled by the magnificent glacier of Nygaard, down which a cold wind continually blows from the immense mass of ice and snow which it discloses.

The Nygaard glacier, which is of great length, descends the valley just mentioned by angular zigzags, resembling a carefully constructed but gigantic highway, embanked at the turnings by its own moraines, and there are three such turnings quite distinct, as seen in the sketch, Plate VIII. The whole is on a grand scale, and the slope, except beyond the highest turning, appears tolerably equable, and the glacier is most likely practicable throughout the greater part of its length. It is in all probability the most regularly developed glacier in Norway. Comparing it with the Swiss glaciers, we find it more winding and steeper than the glaciers of the Aar and Aletsch, less confined than that of Viesch or Miage, and less gigantic and more tortuous than that of Zermatt. It somewhat resembles the Mer de Glace

above Montanvert, but in picturesque effect falls far short of it, owing to the want of a fine background, the view here terminating as usual in the flat-topped snow-fields of the "Fond," a poor contrast to the noble buttresses of the Jorasses and Tacul, and the pinnacles of Le Géant and Mont Mallet. The lower termination is also quite unlike, for the glacier spends itself on nearly level ground at the expansion or *embouchure* of the valley which it occupies. And here we have evidence of the immense fluctuations in dimension to which glaciers are subject within periods by no means remote, probably more striking than is anywhere to be found in Switzerland, not even excepting the case of the glacier of La Brenva, on the south side of Mont Blanc, which I have very fully illustrated elsewhere.* The most inexperienced eye perceives at a glance the enlarged boundaries which the Nygaard glacier has attained within no very great range of years. It is as distinct, indeed much more so, than the limit of spring-tides usually is on the sea-shore. It is marked upon the rocks far above and beyond the present limit of the ice by the clean and fresh dressed surfaces they exhibit, of a shade, too, far lighter than the lichen-grown and weathered slopes of the mountain sides. Where the glacier quits the contact of rock on either side, its ancient limit is marked by the mound of fresh coloured debris which it has driven before it to the utmost boundary of its overflow, and which remains there a monument to future ages of its past extent (like the index of a register thermometer pushed on by the fluid which cannot recall it a hairsbreadth.) All the semilunar space included between this moraine and the existing ice, a plain

* Travels in the Alps, 2d edition, page 205; and 12th Letter on Glaciers, in Edin. New Phil. Journal, vol. xlii., page 94.

of enormous extent, is emphatically *waste*. It is almost level and absolutely covered with rolled stones of every size, from that of an egg to blocks of several cubic yards, loose and free from any cohering soil—to walk over which for such a distance is no agreeable task. Finally, within the whole limits just described, there is literally almost no vegetation. A few blades of grass or a weed may here and there spring up; but they are imperceptible at any distance. Whilst immediately beyond the moraine, vegetation is abundant, and young birch trees are every where making their appearance. This gives quite a different tone of colour to the glacial soil, and renders the limits as conspicuous as we have described them to be.

The interval between the present and former limit of the ice is stated by Bohr, a Norwegian author, at 1726 feet, by Naumann and Durocher, at 2000 feet; and I should think that it is now even more. The diminution of vertical height is estimated by the first-named writer at 200 feet. The period of the great extension of the ice, which was also very rapid, is well known. It was about the year 1740, when the extent of damage to farm property by the glaciers of Justedal became a subject of judicial inquiry.* With reference to this event, I may mention that, when sleeping in Krondal, we learned from our host's father, a man named Tygger, seventy-six years of age, that his mother's father was possessor of the Nygaard or "low farm-house," whose desolation by the encroachments of the glacier gave to the latter its name—that upon the destruction of their pastures, the family migrated to Krondal, bringing, as he affirmed, the timbers of the identical "Nygaard" with them; and he showed us what he declared to

* Bohr in Jameson's Journal, iii. 256 (1827.) Compare Naumann's Travels.

be the original house, which he corroborated by shewing that the logs had been cut with numbers for the purpose of being put together again after removal. The house was small and old enough in appearance. Tygger described this occurrence to have taken place 100 years ago, which was near enough the mark.* I must observe, however, that we noticed elsewhere in Krondal a hut with the timbers numbered in the same way.

It would seem, it must be owned, more probable that these huts, if removed at all, were rescued from the inroads of the glaciers of the Krondal itself. The main glacier, which is now 900 yards within its moraines of 1742 (I give the date of the judicial inquiry into the damage occasioned by it), was estimated by M. Durocher in 1845, to be only 600 or 700 yards distant from them. His measurement of the Nygaard Glacier agreed nearly with that of M. Naumann thirteen years earlier. The glaciers of Lodal and Faabergstol had retreated (as observed by Durocher) 600 or 700 yards within their moraines, whilst that of Trangedal, though almost close to that of Lodal, shows no marks of having diminished. The observations previously made on the glaciers of Fjærland and Bondhuus confirm the fact of the diminution since a period by no means remote. These facts are analogous to those observed in the Alps; and there is even reason to believe that the eighteenth century witnessed a considerable and sudden increase of the glaciers generally in both countries. But, during the last thirty years, there has been a tendency of the Alpine glaciers to

* I here observe in passing, that the information obtained on this and many other occasions from the peasantry would have been entirely lost to me but for the companionship of my friend Mr. D., whose presence contributed as much to the intelligent enjoyment as to the material comfort of the journey.

increase, which seems not to have been noticed in Scandinavia. Indeed, these oscillations evidently depend sometimes on causes so local that we cannot be surprised at the want of a general coincidence.

I made the best of my way on horseback across the stony desert which separates the roadway from the foot of the Nygaard Glacier, slanting towards its southern edge. Dismounting, I scrambled along the moraine bordering the ice, in company with the man whom we brought from Rönneid, and who said he had been once on the glacier before. I proposed to cross it from south to north at a convenient place. This is always a matter of some difficulty and uncertainty, and but for my geological hammer, which I used to cut steps, we must have abandoned it. The character of the ice was *very highly* crystalline, such as we find characteristically in such glaciers as that of Aletsch which have run long courses. The ice was very hard, rough, and sharp, presenting many angular prominences; and the sun glanced from the plates of crystalline texture in a way which I do not recollect to have seen so strikingly except in the Swiss glacier just named. Farther, the general surface of the glacier shewed the gradual obliteration of the more salient outlines, which I have particularly noticed late in autumn on the Mer de Glace, and elsewhere, as one of the most familiar and evident proofs of the "plasticity" of the ice of glaciers on the great scale—the ridges between crevasses sink, the crevasses themselves are gradually cemented by the cohering of the material of the sides bulging under their own weight—all the forms pass gradually from *serrated* into *undulating*. This was so well marked on the Nygaard Glacier, that I have no hesitation in conclud-

ing that, notwithstanding the high latitude and the long winter, the Norwegian glaciers (I speak now of those not within the arctic circle) are in all respects as "viscous" or "plastic" as those of Switzerland—in other words, will, equality of size being supposed, move quite as rapidly upon a given slope. Though I own that this was not my impression before I visited them, it is readily accounted for. The latitude is greater, but the height above the sea is much less; and even if, as may be admitted, the latter circumstance does not increase the average yearly temperature of the valleys in which glaciers occur in Norway so much as the former tends to diminish it, we are to recollect that the summer season is the season of activity in glacier motion; and that the motion in winter, though not inconsiderable, will not be very materially affected by the number of degrees which the thermometer falls below the point of congelation, the more so as the superincumbent mass of snow which protects the interior of the glacier from the severity of the frost is much greater in Norway than in the Alps. A great part of this snow has to be first melted, and the glacier must consequently be deluged by water in the early part of summer even more effectually than in Switzerland. The temperature of the ice is thus rapidly raised to 32°, and the softening influence of external warmth (which is not a matter of speculation but of fact) must be felt to a degree hardly to be paralleled in the Alps. The intensity of the heat (whilst it lasts) in the Norwegian valleys is almost proverbial. During our stay in Justedal, we felt it in its full amount; but, above all, it is scarcely interrupted by nocturnal cold. Daylight never ceases; the superficial congelation which elsewhere arrests, during many hours of

the twenty-four, the circulation of water in the pores of the glacier, must be here almost unfelt, and the tendency to motion and dissolution must be proportionally great.

It is an interesting fact that an attempt was made by M. Bohr to estimate the amount of fusion of the glaciers of Justedal during the period of a summer's day, some years before the recent revival of attention to the phenomena of glaciers in Switzerland amongst scientific men. He compared the discharge of the Storelv where it passes the church of Justedal in the morning and evening of a hot summer's day, and ascribed the difference, or 31,000 cubic fathoms of water *per hour*, or 1860 cubic feet *per second*, to be due to the direct melting of the ice and snow by the heat of the sun.

To return to the glacier itself. Owing to the peculiar condition of the ice which I have described, it was not to be expected that the *veined structure* would be strongly marked, especially as the glacier, where I traversed it, was in the act of spreading itself abroad, ceasing to be confined by the walls of the valley; and, as I have shewn by many instances collected in the Alps, the veined or ribboned appearance of the ice (giving it sometimes exactly the aspect of the finest *cipollino* marble) is unquestionably connected with intense lateral constraint. It was, however, by no means wanting, and was well developed near the contact of the ice with the soil, on its northern bank. I ascended the glacier in the direction of its origin at no great distance from the side last mentioned as far as my time would permit. I found the ice more level and easily traversed as I proceeded, and I should have enjoyed the opportunity of prosecuting my walk farther. There did not, however, appear any peculiarity requiring, or likely to

repay, minute examination, and the day being far spent. I returned, gaining the shore without much difficulty, but had a fatiguing scramble for a great way over the continually rolling stones of the moraine. The lowest part of the glacier I estimated by the aneroid barometer to be 355 feet above the church at Justedal, or 815 (according to my reckoning for Justedal church, which is nearly 200 feet less than that usually given) above the sea. At length I reached the dirty hamlet of Elvekroken, nearly opposite the glacier, where Mr. D. was waiting for me; and after sketching the glacier from a point a little way on the road towards Justedal, I made for the hospitable roof of the parsonage as rapidly as the dangerous footing (for a horse) of the polished rocks permitted.

On our return from Justedal to Rönneid, I noticed a fact which appeared to me to be incontestible, namely, that the level to which the *roches moutonnées* extend on either side of the valley progressively lowers as we approach the sea. This fact, which is also observed in the Swiss valleys, is held to denote, on the glacial theory, the highest level which the glacier at any time attained. From Rönneid we took boat to Solvorn. I spent a day of welcome rest with my former friendly entertainer there, and proceeded on my now solitary journey to Christiania across the Fille-field—solitary, because Mr. D.'s engagements at Bergen required him to take the steamer from Lærdal to Bergen, which sailed this season but once a week.

I left Solvorn in an excellent six-oared boat, upon the Lyster-fiord, for Lærdalsören, with beautiful weather. The banks show considerable cultivation on both sides, and I now, for the first time, saw barley cut, though it was not yet the middle of August; the crops in the best valleys

east of the Fille-field, as well as those of the Hardanger, appeared to be three weeks later, whilst (as already remarked) it seemed doubtful whether at Bergen there would be any corn harvest at all. The upper part of the Sogne-fiord is, therefore, a favoured climate. Very soon after leaving Solvorn, the shores assume a severer and even a gloomy aspect: habitations become less numerous, then almost disappear. The coast is almost entirely rocky, composed of a nearly white, very slaty quartz rock or gneiss, which might sometimes be almost mistaken by its general aspect for limestone. Opposite the Aardals-fiord* the wind shifted,

* The Aardals-fiord leads to some of the wildest scenery of Norway, particularly the Utledal, which runs under the eastern flank of the Horungerne mountains, which separate it from the valley of Fortun and the Lyster-fiord. Part of the scenery of Utledal has been visited by Mr. Forrester, but a still wilder defile, called Vetties Giel, is described by a Norwegian clergyman, Mr. Borgeson, in a paper which, though translated into English,* is but little known. Notwithstanding evident marks of exaggeration in the description, there is reason to think that this is the most inaccessible of the *inhabited* valleys of Norway. For a distance of several English miles the path skirts terrific precipices, or is even excavated in their face; whilst at all seasons of the year, except during one or two of the later months of summer, masses of hard ice must be crossed by the aid of steps cut with a hatchet. In the higher part of this valley the corpses of those who die in winter are kept in a frozen state until the advance of the season allows them to be carried to the grave-yard, or are sometimes tied astride on the back of a sure-footed pony; and, supported by a bag of hay, the dead thus ride to church for the last time. It is probable that Pontoppidan refers to Vetties Giel, though not by name, in his work, vol. i. p. 58, where he speaks of the wildness of some valleys in the Bergen-stift. It would be an interesting journey for an enterprising traveller to verify these descriptions by ascending the Utledal from Aardal, making his way to Vormelid (in Munch's map), and thence either to the Laervand, at the foot of the Ymes-field, or across the Horungerne to Fortun in Lyster. This last was the dead man's ride. The Utledal takes its origin not far from the Store Galdhöpiggen or Ymes-field.

* Edinburgh Philosophical Journal, vol. ix. (1823) p. 299.

from being perfectly favourable, to blowing right a-head, and we had to pull against heavy squalls coming up the Sogne-fiord, until we had got opposite Lærdals-fiord, another inlet towards the east, so as to be able to hoist sail, which carried us towards our destination with a velocity which nearly made up for the delay caused by the change of wind. I reached Lærdalsören in 4½ hours from Solvorn, and found my carriole, which had been sent from Bergen by steam.

Here ended my tour on the western fiords, which extended to almost 50 Norwegian, or 350 English miles, chiefly performed by water, and accomplished in twelve days. A traveller in search of the picturesque alone, would probably omit the Fjærlands-fiord, and would visit the upper part of the Hardanger, called the Eid-fiord, and the Vöring-foss; but otherwise I do not think the tour could be materially improved, except by making it more at leisure than circumstances permitted me to do.*

* Summary of a Tour on Hardanger and Sogne Fiords:—

	Norsk Miles.	
Bergen	0	
Oos	2½	land.
Teroe	3	water.
Bondhuus	3	ditto.
Odde	3	land.
Ullensvang	2	water.
Utne	1	ditto.
Eide	1	ditto.
Nedre Vasende	¼	land.
Ovre Vasende	½	water.
Vossevangen	1⅞	land.
Vinje	1⅞	ditto.
Gudvangen	2⅛	ditto.
Lekanger	3½	water.
	25⅝	

The concluding portion of my tour in Norway consisted of the journey to Christiania from Lærdalsören across the Fille-field, a distance of 29¼ Norsk, or 205 English miles, which I had to perform alone and by carriole (except a short space by water), without any prospect of communicating with a single individual by the way, excepting through the few words or sentences of Danish which I had acquired. I had indeed been nearly in the same plight during part of my journey to Throndhjem, but three persons in company have a show of physical force, or at least *inertia* about them, which renders it less easy and less advisable to molest or impede them than a single stranger. The experience which I had gained before stood me in good stead now. It may, indeed, seem surprising that I had not made more progress in the language, but it is to be recollected, that during my long coasting voyage, the officers of the vessel spoke excellent English, and during my stay in the Bergen-stift, my friend Mr. D. (with whom I conversed in German) undertook the whole duty of interpreter. I believe it may safely be affirmed, that in no country in the world (except perhaps Sweden) can a stranger, ignorant of

	Norsk Miles.	
Brought forward	25⅝	
Fjærland and back	7	water.
Sogndal	1½	ditto.
Solvorn	1⅛	land.
Rönneïd	1⅛	water.
Justedal and back to Rönneid	6	land.
Glacier and back to Justedal	2	ditto.
Solvorn from Rönneid	1⅛	water.
Lærdalsören	2⅝	ditto.
Total	48⅛	

• The expense for two persons, for twelve days (exclusive, of course, of private hospitality), was forty-one dollars.

the language, travel with equal facility and security as in Norway. The admirable system of "forbuds," for ordering horses and accommodation beforehand, renders a traveller nearly independent of spoken language; but it is to *the sterling and still unalloyed integrity and gentleness of character of the people at large* that he is mainly indebted for the ease and agreeableness of his journey.

My "forbud" papers, as I have mentioned, were carefully drawn up beforehand, with the assistance of a gentleman well acquainted with the road and the best inns. I studiously avoided long day's journeys and late hours. This is the best security against the only real annoyance which is at all likely to occur, namely, the chance of an accident or other unavoidable detention. If too many stages be crowded into one day, and the vehicle break down (no uncommon occurrence with the indifferent second-hand carrioles with which most Englishmen are contented), the delay necessary for the roughest repair (if he is so fortunate as to accomplish it) will, in all probability, derange not only that day's journey but the succeeding ones; and thus, whilst he loses all the benefit of the "forbud," he must also pay for the detention of the horses he was unable to employ. On the other hand, if the day's *programme* be short, he is almost certain to make up his lost way by pushing on to a late hour.* No such misadventure occurred to me, and I kept my prescribed time for four successive days without, I believe, more than about half an hour's deviation, nor had I once to wait for horses (except as it happened at Lærdal on starting),

* In event of a carriole being irreparably damaged, the only alternative is to accept any sum for the ruins which a neighbouring postmaster will offer, and pursue his journey in the rough cars which are furnished at the stations.

which were always standing on the road, even though I were before my time.

This punctuality and consciousness of the importance of time, and of knowing habitually within a trifle of what o'clock it is, and keeping engagements accordingly, is a feature not unimportant, I imagine, in the civilization of a people. Although before I travelled in Norway I was quite aware of the *theory* of posting, and supposed that it might be maintained with tolerable exactness on a great line of communication, such as that from Christiania to Throndhjem, it appeared to me nearly incredible that relays should be ready to a minute on unfrequented roads, where days may elapse without a single demand for horses, which, moreover, must be procured from peasants living often five or ten English miles from the post-house. Even the road across the Fille-field is so little traversed that now, in the height of the season, I did not fall in with a single person posting in the same direction, and met but one (English) party in the opposite one. The highway in some places was nearly grass-grown; but still the relays were always ready, the postmaster or his deputy usually on the spot, and (as I was provided with plenty of small coin) the settlement was made in a moment, and without remark, or, more generally, the money was received with thanks. Not the slightest attempt was made on the whole journey (nor on any other which I made in Norway) to exact a penny more than the legal fare, nor in any way or manner to take advantage of a traveller whose helplessness, as regards the language, and, consequently, explaining or enforcing his rights, was only too palpable. Yet I cannot too strongly urge the immense advantage which even the casual traveller enjoys who has made himself acquainted, however

slightly, with the Danish language. It is usually considered an easy acquisition, especially to one who is conversant both with English and German. I cannot say, however, that I found it so. The German word was sure to occur where it should have been the English one, and *vice versa*. Besides, there is a large infusion of words resembling neither language, especially of the shorter ones—prepositions and the like—which give an entirely strange sound to the spoken tongue. Unfortunately there is no good or even tolerable Danish and English dictionary, nor any grammar well adapted to the traveller's use.

I need not describe minutely my journey from Lærdal to Christiania. Mr. Murray's handbook of Norway does so with praiseworthy accuracy, though with a strong tendency, I must observe, to enhance, even to exaggerate, the romantic character of the scenery. It must unquestionably appear more interesting to a traveller going towards Bergen than to one proceeding in the contrary direction. There will then be a gradual increase in the sublimity of the landscape, and some of the best views will be more naturally presented. But to any one acquainted with the scenery of the Alps or Pyrenees, or even the best mountainous districts of Britain, the route of the Fille-field will hardly excite much enthusiasm. The most interesting points are the old church at Borgund, the pass of the Fille-field, the lower part of the Little Miösen Lake, and the Ringerige. I will say a few words on each of these. The church of Borgund is situated near the road on the third stage from Lærdalsören, and is, as usual, nearly solitary. It is built of wood, tarred, and is believed to have resisted the storms of this inclement sky for six centuries. It is

one of the few remaining specimens of the ancient churches of Norway which have a grotesque character almost oriental. This at Borgund, and the church at Hitterdal (of which a view may be seen in *Forrester's Norway*), are the two best, if not only remaining specimens, except indeed one which was removed as a curiosity by the king of Prussia. The church at Borgund has a centre and two side aisles, two transepts, an apse, a spire, and a covered walk or passage surrounding the whole. The interior has something of the character of Norman architecture infused into its rude wooden fittings; the exterior is covered with angular projections, and surmounted with fantastic crochets and ornaments which defy description, and which recall the absurdities of some Chinese ornaments. The whole is on a considerable scale, and is in perfect repair. It is impossible to describe the singular effect which so grotesque an object produces amidst surrounding scenery of a remarkably severe character. The belfry is a separate wooden tower at a little distance from the church, also very peculiar, and, it struck me, more pleasing.

The ascent of the Fille-field is more picturesque in its lower than in its higher portion. There are some fine passages through ravines and amidst fallen masses of rock, quite in the Salvator Rosa style, and which any where but in Norway might suggest the notion of lurking banditti. The final ascent to Maristuen, and for a mile or two beyond it, is rather monotonous, and the hills are covered with snow patches, but not reaching the snow line, have, as usual, a dreary aspect. The summit level is a bleak and nearly horizontal pass between two ranges of mountains of no great height—the road attaining 3900 English feet above the sea, and the highest point of the neighbouring range,

being the Suletind, rising to 5890 English feet, which is said to command very fine views of the mountains to the north, including the Horungerne and Ymes-field. The road, however, does not command any extensive views, being conducted through a natural depression in the chain. The birch disappears at the highest level, but reappears at Nystuen, which is very little lower on the eastern side, a comfortable inn, situated in a cold valley beneath a crag of black metamorphic rock, with a gloomy lake at a lower level.

The descent brings us to the upper end of the Little Miösen Lake, which is bold but bare. The lower end offers a scene of remarkable beauty—especially as seen in



coming from Christiania; the lake has contracted to a strait, then widened into a lesser basin, whose southern side is extremely precipitous, and surmounted by one of the steepest highways in Norway.* The rocks are adorned with

* The state of this thoroughfare a century ago is thus graphically described by Pontoppidan :—"The most dangerous though not the most difficult road I have met with in my several journeys in Norway, is that betwixt Skogstadt and Vang, in Volders; along the fresh water lake called Little

hanging wood, chiefly spruce fir and birch. Farther on, the country becomes more level, and the road passes through dense woods of spruce, which pleasingly contrast with the bareness of the Fille-field. We are now in the district called Valders, a peculiarly peaceful and industrious region, resembling in many respects some of the lower parts of Switzerland, to which the number of goodly farm-houses, with extensive barns and out-buildings, in some measure contributes. The peasants are civil, and primitive both in manners and dress; the horses excellent. The crops of oats and barley were abundant though late. There is also much pasture, and cultivated ground is everywhere interspersed with fine woods of fir. The road pursues for a great way the banks of two lakes, the Slidre and Strand fiords, which are only moderately picturesque. Though well kept, it is exceedingly little travelled, and the unnecessary ascents and descents are countless. Below Strand-fiord the river makes repeated expansions into small lakes, the declivity being inconsiderable; and after the station of Frydenlund we quit altogether this valley, which we have followed since Nystuen, and pass a low *col* covered with spruce fir, and after a most rugged ascent and descent find ourselves at Bruflat in a very picturesque valley leading to the Rands-fiord, a fine expanse

Mios, the road on the side of the steep and high mountain is in some places as narrow and confined as the narrowest path, and if two travellers meeting in the night do not see each other soon enough to stop where the road will suffer them to pass, it appears to me that they must stop short without being able to pass by one another, or to find a turning for their horses, or even to alight. The only resource I can imagine in this difficulty is, that one of them must endeavour to cling to some corner of this steep mountain, or be drawn up by a rope if help be at hand, and then to throw his horse down into the lake, in order to make room for the other traveller to pass."—*Pont.* i. p. 59, *Note.*

of water, some 40 English miles in length. The scenery between Bruflat and the lake, consisting of wood, crag, and river, was amongst the prettiest of its kind which I saw on my journey; the whole reminded me strongly of Styria and Carinthia, where the spruce fir grows in similar profusion. The character of the people in this valley seems far less genial than in the district of Valders. The Randsfiord is a striking piece of water, and its banks appear in many places highly cultivated, and populous for Norway. I sailed down it on board of a steamer, but, unfortunately, in a torrent of rain. I then traversed the picturesque district of the Ringerige and Krogkleven also in pouring rain, but the following day had fortunately fine weather as I regained the banks of the Christiania-fiord, and with pleasure found myself once more in the cheerful and hospitable capital of Norway.

At Christiania I was fortunate in meeting many friends, both Norwegian and English, which proved a welcome change after a long comparative solitude. I returned to England with little delay, except a day or two spent at Copenhagen in visiting its interesting collections and delightful neighbourhood. I crossed the North Sea from Hamburg to Hull.

CHAPTER IX.

ON SOME POINTS IN THE PHYSICAL GEOGRAPHY OF NORWAY,

CHIEFLY CONNECTED WITH ITS SNOW-FIELDS AND GLACIERS.

INTRODUCTORY REMARKS. § 1. ON THE CONFIGURATION OF NORWAY—ITS GROUND PLAN—ITS MOUNTAINOUS DISTRICTS OR FIELDS ARE USUALLY PLATEAUX—LARGE PROPORTION OF ELEVATED AREA—THE KJÖLEN MOUNTAINS—THEIR EXISTENCE DENIED BY SOME GEOGRAPHERS—THREE SECTIONS OF NORWAY. § 2. ON SOME PECULIARITIES OF THE CLIMATE OF NORWAY—LESS SEVERE THAN COMMONLY SUPPOSED, OR THAN ANY OTHER LAND IN THE SAME PARALLEL—THE CAUSES OF THIS—THE SUMMER AND WINTER CURVES OF EQUAL TEMPERATURE—CONTRAST OF THE TWO SIDES OF THE PENINSULA. § 3. ON THE POSITION OF THE SNOW-LINE IN NORWAY—MAINLY DETERMINED BY THE SUMMER TEMPERATURE—PARTICULARS OF OBSERVATIONS ON THE SUBJECT—ON THE LIMIT OF GROWTH OF THE BIRCH—INFLUENCE OF THE SEA IN DEPRESSING THE SNOW-LINE—TABLE OF RESULTS.

AMONGST the many questions with which a stray traveller is sure to be addressed by the peasantry of a remote country, one of the most puzzling to answer is, as to the pleasure or information he can find in looking at *their* hills and waters, and woods and snows. Has he not enough of such things at home? What value have stones and plants, which lies utterly concealed from the eyes of the inhabitants, to whom they belong, but which can tempt the wealthy stranger to lose his time, his money, and his com-

fort, in examining, perhaps in collecting them.* The naturalness of the enquiry; the reality of the paradox, makes the answer often difficult. There are very many persons of opportunities far superior to these poor peasants, who can form nearly as little idea of the motives for such toilsome journeys. To them, the country is the country everywhere, its stones are stones merely, its glaciers and its lakes are *accidents*, which suggest no particular conclusions except as they give a momentary variety to the landscape, or as they affect the value of the soil.

What comparative anatomy is to the study of living beings, physical geography, or the comparison of different countries, is to the study of the earth we live on. The interest of each part is beyond measure increased by comparing it with other parts; and the more such comparisons we are enabled to make, the more distinct meaning can we

* The inability of the peasantry to ascribe any other motive than interest or compulsion to such journeys, is amusingly experienced by every traveller off the beaten tracks, in the theories which are formed as to his vocation. This is nowhere the case more than in the more secluded parts of France. I once amused myself by reckoning up the conjectures as to my business, and the motives ascribed to me, during a journey of no very great extent, which included, as well as I recollect, the following, besides guesses nearer the mark:—An engineer of mines, a government surveyor, a *garde forestier*, a tax-gatherer, the descendant of a confiscated noble of the first revolution surveying his paternal acres, a criminal escaping by bye-paths from justice, an iron-merchant, a stone-mason, and a gold-finder. Of these various *aliases* the last is probably the most inconvenient. I recollect travelling through the mountains of Cogne with a half-witted fellow, a sort of crétin, for a guide, who, after hearing all the explanations I had to give of my journey, constantly returned, with a malicious leer, to the loss the country suffered by ignorance of the treasure which lay about in it, *particularly under the glaciers*, and which more knowing strangers assisted, he insinuated, by mystic arts, could turn to an excellent profit.

attach to even a few slight and seemingly isolated observations in a country wholly new to us, as when Owen reproduces the skeleton of a long extinct bird from a few imperfect bones brought from the Antipodes.

To construct the orographical map (map of mountainous regions) or skeleton of a country, is a more difficult task than it might at first appear to be. The materials for a complete *relief* or model exist for but a few very limited portions of the globe. The materials for maps are gathered from comparatively limited observation. The *tact* necessary for perceiving the peculiarities of the configuration of a country is only to be acquired by practice; and, when acquired, it leads to skilful and interesting generalization. A general commanding an army, a geologist exploring a district, and a foxhunter pursuing his sport, each in their way acquire a facility analagous to that of the comparative anatomist just referred to, in apprehending the whole from a part, in predicting what will be the probable course of a mountain-ridge or of a river which he has not yet seen, and in finding a practicable passage across an intricate and difficult country by which even a native might be bewildered. Since then even the mere basis or skeleton of a country possesses so much distinctive character, and offers so many subjects of interesting contrast and comparison, it is very obvious that the details of structure, as well as of the various plants which embellish it, animals which live upon, as well as rational beings which people it, with their peculiarities of occupation, habits, and dress, furnish an exhaustless field in which the most restless curiosity may expatiate. But to explain all these sources of interest to the more ignorant class of peasantry is impossible, though here and there intelligent men may be found, even in the

humblest class, and in all countries, who possess that spark of divine mind which only requires to be roused, and which sometimes unexpectedly responds to the well-meant effort of the traveller to enlighten him as to his occupations and interests.

The only part of the physical geography of Norway of which I intend here to offer the slightest sketch, is what regards the distribution of perpetual snow and of glaciers, being the objects of my chief observations recorded in the preceding pages. A comparison in this respect with the Alps offers much interest, and though my contribution may be slight and inconsiderable, it will, I am persuaded, lead the way to systematic enquiry by those more favourably placed for pursuing it. Norway itself assuredly does not want for persons thoroughly qualified to obtain and make use of the information thus desired.

The existence of perpetual snow, the elevation at which it begins above the sea level, and the formation of glaciers depending for their origin and nutrition upon these snow-beds, are complicated phenomena referrible by analysis to a variety of causes or conditions. Of these, the most important are the configuration of the soil, and the climate, which last is itself a complex and somewhat undefined fact.

I shall, for greater distinctness, reduce my remarks to different heads; and under some of these I shall endeavour to classify several of the facts incidentally referred to in the previous chapters.

§ 1. *On the Configuration of Norway.*

As there are few parts of the world where snow lies in summer at the level of the sea, the existence of perpetual snow depends in Norway, as elsewhere, upon the greater or less elevation of the mountains. The general height of mountains in Scandinavia is inferior to that of the Alps, Andes, Caucasus, or Himalaya, and is therefore so far in accordance with the generally received opinion, that the elevation of the land diminishes from the equator towards either Pole. The highest ground in Norway is 8500 feet above the sea level, in latitude 61½°; but whilst the country is justly accounted a mountainous one, it is so rather in respect of its general elevation, than from the conspicuousness of its isolated summits. Sweden is comparatively low and tame; Norway defends it, like a huge breakwater, from the invasion of the North Sea, whose force is indeed still tremendous, but which, from the traces of former convulsions, would appear to have been the seat of powers still more energetic. The ragged outline of the coast, the depth of its inlets or fiords, the boldness of its headlands, the multitude of its islands, often almost undistinguishable from the mainland, are facts familiarly known. They seem to show that the boundary of sea and land has been decided only after a prolonged struggle, and that great masses of the latter have gradually been undermined or abraded, so that a tolerably permanent condition has only been obtained when, after the crumbling of lesser obstacles, the mountains themselves have become the buttresses of Scandinavia.

The configuration of Norway may be conveniently con-

sidered in two portions; the comparatively narrow district, extending from near Throndhjem to the North Cape, a distance of above 600 English miles, and the more expanded part, 400 miles in its greatest dimension, from Throndhjem to the Naes of Norway. Throughout the former, the mountains cling, as it were, to the coast; and the boundary between Sweden and Norway is only one-fourth of the breadth of the peninsula distant from the North Sea, which yet includes all the more considerable elevations. South of the Syl-field (lat. 63°) the high ground occupies by far the greater part of the breadth of Norway in its widest extension, and fully half the breadth of the peninsula in the parallel of the Dovre-field. This is due chiefly to the expansion of the coast to the westward, where mountains of enduring crystalline rocks form that prodigious *lobe* of land dividing the North Sea from the Skagerack, which, bearing the whole brunt of forces which appear to have come from the north, not only defended the entire North of Europe from the shock, but probably furnished by their attrition the material of which the low grounds of the continent of Europe are mainly composed.

In this general disposition of the mountainous masses of Norway we see a strong analogy to the west coasts of our islands, and likewise to those of North and South America. It appears almost certain that a common cause has devastated the western shores of nearly every continent.

The forms of the Norwegian mountains have been very generally mistaken by geographers. They do not constitute either unbroken chains rising from the low grounds and forming a ridge, nor are they a series of distinct detached elevations, but, in the southern division of the coun-

try especially, they form *plateaux*, or table-lands, of great breadth, and generally more or less connected together, though occasionally separated by deep but always narrow valleys. In the description of the view from Sneehättan, I have endeavoured to convey a clear idea of these wonderful expansions of mountains, often so level, that upon what may almost be called their *summits* a coach and four might be driven along or across them for many many miles, did roads exist, and across which the eye wanders for immense distances, overlooking entirely the valleys, which are concealed by their narrowness, and interrupted only by undulations of ground, or by small mountains which rise here and there with comparatively little picturesque effect above the general level.

These table-topped mountains are the *Fields*, or more properly *Fjelds*, of Norway, which in their less interrupted or more elevated parts have acquired specific names. They have been very erroneously supposed by map-makers to form a continued ridge serpentining through the country, though preserving a general parallelism to the coast, of which the chief (from north to south) are the Dovre-field, the Lange-field, the Sogne-field, the Fille-field, and the Hardanger-field.

The error in question is easily traced to the usual method of constructing a map from rude and imperfect observations. The river-courses are first determined with a certain accuracy,* and from analogy (rather a precarious

* The river-courses preserve a surprisingly exact parallelism on the south-eastern slope of the peninsula, from the Skagerack to near the head of the Gulf of Bothnia. The direction of these lines of fissure is about 30° with the meridian in Southern Norway, but above 40° in Lapland. In neither case, probably, does it coincide with the direction of greatest declivity of the general surface of the continent.

one, however) with other countries, the origin of these is traced to a *water-shed* or ridge, assumed to be comparatively narrow, along which the chief summits are to be sought, and supposed to be extended merely by *spurs*, or lateral ranges of small extent between the valleys. To such a theory, the construction of the common maps of Norway may be easily traced, and the *tradition* of this unbroken chain may be found in nearly every map.

Thus the general surface of the country is in reality composed of elevated and barren table-lands. The proportion of arable land (land which *might* be tilled), to the entire extent of Norway is not, according to the competent authority of Professor Munch, more than 1 to 10; and if we exclude a few local enlargements of the plains near the capitals, it would not even exceed 1 to 100. By a rude estimation on Professor Keilhau's map, I find that the portion of the surface of Norway south of the Throndhjem-fiord which *exceeds* 3000 feet above the sea, amounts to very nearly 40 per cent. of the whole; and when it is recollected that only one summit exceeds 8000 feet, and that the spaces exceeding 6000 are almost inappreciable on the map, it will be more clearly understood how completely the mountains have the character of table-lands, whose average height probably rather falls short of than exceeds 4000 feet.*

The centre of gravity of the elevated country preserves a rough parallelism to the coast, although from the prodigious indentations made by the larger fiords, the bases of the higher mountains are often washed by salt, or at least brackish water. Of the outlying portions which approach

* These estimates refer to German or Rhenish feet, which are about 3 per cent. longer than English.

nearest to the sea, the most remarkable are the mountains of Justedal and the Folgefond, both of which are covered with perpetual snow.

In the northern district of Scandinavia, where the theory of a ridge is in some respects less inaccurate than in the south, its insufficiency was clearly discovered by the difficulty or impossibility of defining the line of demarcation between Norway and Sweden by that of a continuous water-shed. Such a ridge, if it exist at all, must be held in some cases to run up to the very coast of Norway, or even beyond it into the islands; in other places it dies out altogether, and is resumed with a change of direction.* The present boundary between Norway and Sweden was defined by a joint commission of engineers in the middle of the last century, and is represented on nearly every map as the exact direction of a slightly zigzag chain of mountains, called the Kjölen or Kœlen. This is assumed, in most maps, to be prolonged along the border of the two countries considerably to the south-east of Throndhjem, and it was even long maintained that a mountain mass existed there of prodigious elevation, from which a great many rivers, particularly the Glommen, the Göta, and the Dal, take their rise. The height of this fabulous mountain was even assumed to be 12,000 feet. It is, however, only a slight and lower extension of the plateau of the Dovre-field beyond the deep valley of the Glommen, and its greatest height does not amount to 5000 feet.

* Pontoppidan was not unaware of this, for he states, that in Finmark the Kœlen ridge in many places breaks into large valleys, and consequently is not so continued as farther towards the south, and that it seldom reaches above 4 leagues in a continued chain.—*Nat. Hist. of Norway*, i. 40. The worthy Bishop of Bergen, though not unjustly accused of credulity, was evidently well read in the science of his time in several departments.

Perhaps, however, those Scandinavian geographers go too far who insist that the existence of the Kjölen is purely *mythical*, and that they must be "hunted and expelled" from our maps. The able researches of Wahlenberg, Keilhau, Vibe, and Munch, and the improved charts of the coast, have thrown the greatest light on the form of the country. The *contoured* map of Keilhau, though of course in many places conjectural, gives us a tolerably accurate picture of the general relief; and though the Kjölen range be broken, sometimes almost annihilated, now pushed inland, and now bounding the very shore (as at Fondal, lat. 66½°, and Lyngen, lat. 70°), it must, I think, be admitted, that it is worthy of being classed amongst mountain ranges.* It has not in the far north the peculiarly tabular form of the southern mountains, and is distinguished by many summits of noble forms, and a grandeur disproportioned to their absolute elevation, as the Seven Sisters, the Lofoddens, and the Pippertinderne. It attains its greatest elevation (I speak now of the northern division), at Sulitelma, in lat. 67½°, being no less than 6200 English feet. Sulitelma is not an isolated mountain, but forms part of a wild and extensive group, first visited and clearly described by Wahlenberg, who justly characterises it as the centre of the Alps of Lapland.

It is true that there are at intervals passes across the Kjölen mountains which are extremely low. Such is the frequented road from Throndhjem to Sundsvall on the Baltic, the ascent of which is everywhere easy, and which attains a height of only 2000 feet above the sea. About

* Wahlenberg, surely a most competent authority, continually speaks of the "alpium jugum" in describing the course of the mountains between Norway and Sweden.

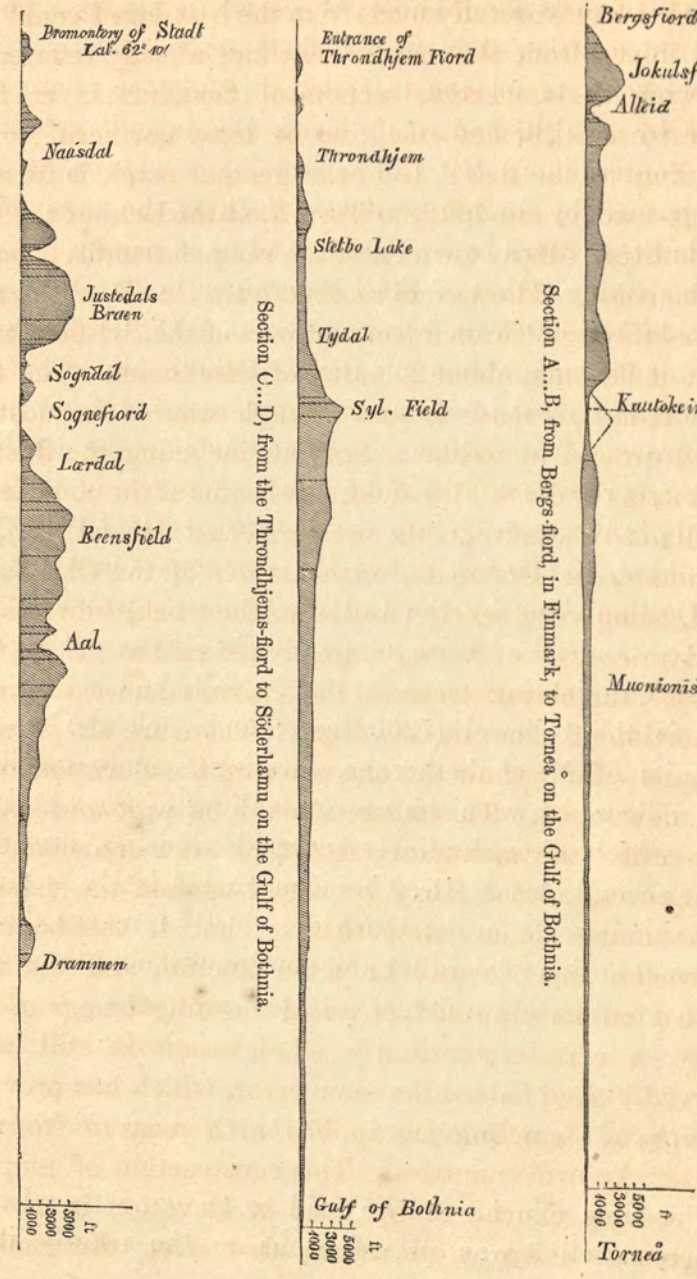
lat. 64°.3 there appears to be a distinct depression in the chain near the Namsen river. In lat. 68°.3, which is that of the Lofoddens, there is a pass across the peninsula by the lake of the Torneå Trask, which is elevated no more than 1300 French feet, whilst the well known track from Alten to the head of the Gulf of Bothnia, by Kautokeino, does not exceed 864 French feet, according to Von Buch, and beyond this the mountains never resume their continuity. A detached summit (Rastekaise) reaches 2700 feet; the North Cape itself (on the island of Mageroe) attains little more than 900 feet. From this point eastwards the country becomes tame and level, nor do the northern parts of Russia or Siberia offer, probably, any considerable elevations, with the exception of the more depressed part of the chain of Oural.

That the elevation of the Kjölen mountains is the result of forces exerted parallel to an ideal axis, is illustrated by the general uniformity of the declivity on the side of Lapland. A very remarkable chain of lakes, one or more of which occur upon almost every river emptying itself into the Bothnian Gulf, and nearly equi-distant from the coast, at a level also tolerably uniform, it is believed, at from 1200 to 1500 feet, point out a symmetry in the fall of the ground throughout nearly the whole extent of the peninsula.

The map which accompanies this work, though on a small scale, has been constructed with great care from a variety of authorities, principally Norwegian. An attempt has been made to represent the elevated plateaux which constitute the high land of Norway, and to annihilate that stiff ridge of mountains which figure in almost every map from the Lindesnæs to the North Cape.

I close these remarks by referring to three sections

which I have carefully made from the best data I could find, and chiefly from the map of Keilhau already referred to, showing the transverse section of Scandinavia at three characteristic places—the first or most northern (corresponding to the line A B on the general map), is from the Bergs-fiord, in lat. 70°.2, to Torneå, at the head of the Gulf of Bothnia. Here the axis of the range has entirely passed to the coast. The second section (from C to D on the map) passes through Throndhjem and part of the Syl-field to the Gulf of Bothnia, about 2° north of Stockholm. The third section, E F, is made to pass through some of the most elevated ground in southern Norway, including the Justedal mountains and the Fille-field. It begins at the conspicuous headland of Stadt, on the western coast (lat. 62° 10′), and terminates at Drammen, on a branch of the Christiania-fiord, being very nearly parallel to the marked direction of the river courses of Norway already referred to. In all these sections, the elevations are to the horizontal measures in the proportion of about *thirteen to one*. These are all *prominent* sections. They show the character of the elevations when well developed. That there should be profound valleys intersecting the mountain ranges, or even occasional discontinuities, cannot fairly be urged against the existence of mountain chains altogether. Though the boundary of Sweden and Norway be often fanciful, and the maps founded on its supposed physical meaning be egregiously wrong, a certain continuity of elevation is still to be observed. And indeed the same error, which has prevailed in maps of Scandinavia, applies in a measure to those of better known countries. The construction of maps by river courses instead of by lines of elevation is general; and geologists are well aware that even the chain of



Section E...F, from Stadtland, in Nord-fiord, to Drammen on the Christiania-fiord.

Section C...D, from the Throndhjems-fiord to Söderhamn on the Gulf of Bothnia.

Section A...B, from Bergs-fiord, in Finmark, to Torneå on the Gulf of Bothnia.

Alps, which is remarkable for its continuity, is arranged in groups rather than in a defined ridge. Many of the passes seem to let the traveller through the chain as it were by stealth, and really mark the boundary between two conterminous *blocks* of mountain, or *massifs*, as they are termed by foreign writers. Such is the pass of the Little St. Bernard as well as the Col de la Seigne, and still more strikingly that of the Finstermunz in Tyrol (Reschen Scheideck, 4600 feet), between the huge Oertler Spitz and the glacial mountains of the Oetzthal. Some of the highest and most imposing summits, instead of occupying the crown of the ridge, are found in lateral subordinate ranges, or even in the mere spurs or offsets of the great chain of Alps. Such are the *massifs* of Mont Pelvoux in Dauphiné, 13,500 feet above the sea, communicating with the Cottian Alps by the Col de Lautaret, which is only 6700. Such the entire range of the Bernese Oberland, whose culminating point is 14,100 feet, and whose isthmus is the Grimsel (7200 feet); and such the majestic summits of Mischabelhörner, forming a mere outlier of Monte Rosa, between the narrow valleys of Saas and Zermatt, which, though almost unseen by tourists, are giants of the second class. Dr. Thomson, in his lately published and curious work on the Himalaya, justly remarks that the universal notion of parallel and continuous mountain ranges is to a great extent a delusion of perspective.

§ 2. *On some Peculiarities of the Climate of Norway.*

The time can hardly be said to be gone by when an erroneous belief was prevalent as to the utterly inhos-

pitable climate of Norway. Bishop Pontoppidan cites the amusing mistake of our English Bishop Patrick, who describes a Norwegian as imagining a rosebush to be a *tree on fire;* whereas roses are common flowers in many parts of Norway. He farther adds that the harbour of Bergen is not oftener frozen than the Seine at Paris, that is, two or three times in a century, whilst the harbours of Copenhagen and Lubeck are frequently blockaded with ice. This he justly ascribes to the influence of the open sea. A still more singular fact is, that the smallest piece of drift ice is unknown on any part of the Norwegian coast, though it extends to lat. 71°, while off the coast of North America they are occasionally seen in lat. 41°.* Until a comparatively recent period, it was generally believed that the temperature of the North Pole was 32°, of the Equator about 86°, on an average of the year, and that every place had an intermediate temperature depending solely on its latitude. The influence of sea or land in great masses in altering the climate—the former as a general moderator of extreme heat and cold, the latter in increasing the inequalities of climate—was next perceived, and the inflections (as they are called) of the isothermal lines were clearly indicated by Von Humboldt. The isothermal lines are lines which pass through all points of the earth's surface in each hemisphere which possess the same average temperature. If the temperature depended solely on the latitude, they would form accurate parallels of latitude. But as the continents are hotter than the ocean between the tropics, and colder in higher latitudes, the lines of temperature have a

* See the limit of drift ice indicated in the vignette map accompanying the General Map of Norway in this volume.

descending loop over the Atlantic and Pacific Oceans in the former circumstance, and an ascending one in the latter.* Thus, for example, the isothermal line of 40° Fahr., which passes nearly over Throndhjem in Norway (lat. 63°), and attains perhaps the 66th degree of latitude over the Atlantic, falls to the 48th degree in Canada (a little north of Quebec), and to the 50th or lower in the eastern parts of Asia, but rises again under the influence of the Pacific Ocean to about 60° of latitude on the western coast of North America.

A farther step in these important and curious generalizations (which are due primarily to Von Humboldt), consists in distinguishing the *summer* and the *winter* curves of temperature, which have an important bearing on the existence of perpetual snow and glaciers. Places with the same *average* temperature may be yet, the one temperate and wholesome, the other nearly uninhabitable from extreme cold during winter, which is compensated by the almost tropical heat of the summer months. Thus whilst at Throndhjem the difference of temperature of January and July is 40° Fahr., at Jakutzk, in Siberia, which is nearly on the same latitude, this difference amounts to 114°, and mercury is sometimes frozen for three months of the year. In the Faroe Islands, on the other hand, the climate of which is perfectly insular, the variation between January and July is only about 18°.

Whilst, then, Norway enjoys an *average* climate superior to any other continental country in the same latitude, it is also, on the whole, less visited by extremes of summer heat and winter cold. No doubt the different portions of

* See the map of Isothermal Lines in Berghaus' and Johnston's Physical Atlas, or in the neat and cheap maps published by the National Society.

the country vary strikingly in this respect, the coast possessing the moderate or *insular* character, the interior or Swedish side a much severer one; still, on the whole, the statement is true. It is vividly represented by the isothermal lines for January and for July, drawn by Professor Dove of Berlin, and copied in the small chart which occupies one corner of the map accompanying this work; which at the same time shows the general position of Norway relatively to other countries, where it is observable that the northmost portion extends as near the Pole as the centre of Greenland. The blue curves which pass through places believed to have the same mean temperature of the month of January, show that we must penetrate farther towards the Pole in the neighbourhood of the Norwegian coast in order to attain a given degree of winter's cold than in any other part of the northern hemisphere. In fact, we may conceive the Atlantic as moderating the effect of winter by pouring in a flood of heat towards the arctic seas, through the enormous strait between Greenland and Norway which connects the Atlantic Ocean with the proper "Polar Basin," if such exist, and this flood of heat spends itself chiefly or entirely on the Norwegian side of the opening—the January isothermals falling with extreme rapidity into lower latitudes on the inhospitable coast of Greenland. Now this general expression of the phenomena evidenced by the isothermal lines, has, as is well known, a physical cause precisely corresponding to it, and sufficiently explaining it. This is the continual direction of a current of the Atlantic waters having the high temperature due to southern latitudes precisely in the line in which the arctic cold is thus powerfully repelled. The "Gulf Stream," taking its rise in

the Gulf of Florida, proceeds northwards and eastwards, until it breaks on the shores of Europe and northern Africa, a portion of it striking the western coasts of the British Isles, and being prolonged to the coast of Norway, imparting warmth to water and to land, and effectually repelling the invasion of floating ice with which Finmarken would otherwise be continually menaced.* It has been calculated that the heat thrown into the Atlantic Ocean by the Gulf Stream in a winter's day would suffice to raise the temperature of the part of the atmosphere which rests upon France and Great Britain from the freezing point to summer's heat. The fact of such a transference of the heated waters of the tropics into Northern Europe is popularly but convincingly proved by the common occurrence of finding West Indian seeds and woods upon the west coasts of Ireland, Scotland, and Norway. Captain Sabine relates that in the year 1823 some casks of palm oil were thrown ashore at Hammerfest (lat. 71°), which were traced to the wreck of a vessel the year before at Cape Lopez, in Africa.† The general direction of the Gulf Stream (only its feebler and reflected part, however) on the coast of Norway is indicated on the little chart before referred to, whilst on the west of the Atlantic a reverse stream marked "Polar Current," is shown descending from Spitzbergen and the "Polar Basin," between the coasts of Iceland and Greenland, charged with icebergs, and of course approaching the temperature of freezing salt water. This mass of water spends its cold on America as the Gulf Stream does its heat

* Il faut s'eloigner de 20 à 30 lieues marines des derniers promontoires (North Cape) avant d'apercevoir des ilôts de glace; encore sont-ils bien loin à l'horizon.—Von Buch, Annales de Chimie et de Physique, vol. ii. 1816.

† Note to Cosmos.

on Europe, and finally sinks under the warm current off the coasts of the United States.

The position of the red curves which pass through places which have the July temperature alike, is altogether different from that of the winter curves: indeed in part of Norway (as also in Great Britain), they are very nearly at right angles. The summit of the July curves is found in Siberia, where the summer heat is overwhelming, which is moderated as we approach the shores of the ocean. *It is by the amount of the summer heat that the limits of perpetual snow are mainly determined.* The part of Norway beyond the arctic circle is of course exposed to the continued action of the sun, day and night, during part of summer, hence the rapidity of vegetation, and the intense heat which in some places prevails for a short time—the thermometer, as we have seen, rising to 84° at Alten in lat. 70°.

The two sides of the Scandinavian Peninsula differ exceedingly in climate, the eastern part tending to the continental, the western to the oceanic climate. The contrast between Bergen and Christiania in this respect has been stated in a former chapter. The table-land of Norway forms in all its extent a most important barrier, which commonly separates the most opposite states of weather. The rain at Bergen is several times as great as that at Christiania. It falls chiefly in winter—that of Christiania in summer. When it rains or snows east of the Fille-field, it is most probably fine on the west. A sort of intermediate climate occurs on the western depression of the continent, but at some distance from the coast, and offers an interesting peculiarity; it is the climate of the interior of the fiords, as on the Hardanger and Sogne near Bergen, the Throndhjem-fiord above that town, and Kaa-fiord as con-

trasted with the climate of Hammerfest. In all these cases the climate improves as we recede from the shores, the corn ripens better, the mean temperature is higher, and, at least in the far north, vegetation is more luxuriant. This arises mainly from the excessive amount of rain, fog, and cloud, which lowers out of all proportion the temperature of summer in the immediate neighbourhood of the coast. Bergen is universally known as one of the most rainy spots in Europe, and its position manifestly resembles that of Westmoreland, of Penzance, and of Coimbra, which enjoy an unenviable pre-eminence in this respect. The average fall of rain at Bergen exceeds 77 inches, while that at Upsala, on the continental side of Scandinavia on the same parallel, is only 16 inches. At Bergen 21 per cent. of the annual fall is in the three summer months, whilst at Upsala it amounts to 33 per cent.* At Ullensvang, on an interior branch of the Hardanger-fiord, though plunged in the midst of lofty mountains, the climate has already greatly improved. At the head of the Sogne-fiord it is still better. The barley was ready there for the sickle when it was hopelessly green near Bergen. In Finmarken, again, the interior fiords, and the valleys connected with them, surpass incomparably in climate the islands and outlying portions of the coast. The valleys of Bardu and Lyngen are the most northern corn lands in the world, and at Alten the Scotch fir attains a height of 780 English feet above the sea, and the birch of 1500 feet. At Hammerfest, which is on an island exposed to the sea, and less than one degree of latitude farther north, nature seems almost torpid, the fogs are continual, the birch trees are mere bushes at the level of the sea, and scarcely anything can be reared in the

* Schouw, Climat d'Italie, pp. 170, 171.

gardens. In short, we have the climate of Iceland—neither excessive heat nor cold, but a benumbing mediocrity of temperature and a perpetual cloud.

§ 3. *On the Position of the Snow Line in Norway.*

The occurrence of perpetual snow at a certain height above the sea in even the warmest regions in the globe, has in all ages excited the curiosity of geographers and naturalists. Regarded at first as a very simple indication of the depression of temperature as we ascend in the atmosphere, it has been carefully studied and applied (often erroneously), to the determination of climate. Closer examination has shown that the presence of perennial snow—in other words, a predominance of all the causes tending to its accumulation over those which tend to its waste or fusion—is, indeed, a very complicated fact, and cannot be taken as the simple expression of any one of the elements of climate. The snow line is far from having invariably a mean temperature of 32°, as was at one time supposed. Under the equator it is about 35°; in the Alps and Pyrenees about 25°; and in latitude 68° in Norway it is (according to Von Buch) only 21°. Yet though there are regions both in the extremity of Siberia and in arctic America, of which the mean temperature is below zero of Fahrenheit (as, for example, Melville Island), it is quite established, on the concurrent authority of those best acquainted with these regions, that *nowhere in the Northern Hemisphere* does *the snow line attain the level of the sea.* The explanation is to be sought principally in the intensity of the summer heat during the period of perpetual day, which effectually thaws the soil, though

only to a trifling depth, and raises upon its surface a certain amount of brief vegetation suitable for the support of arctic animals.

Another cause affecting exceedingly the level of the snow line is the amount of snow which falls. The interior of continents being far drier than the coasts, the snow to be melted is a comparatively slight covering. The snow line on the *north* side of the Himalaya is at least 3000 feet higher than towards the burning plains of Hindoostan. This is chiefly due to the excessive dryness of the climate of Thibet. In like manner, five times less rain falls on the coast of the Baltic than at Bergen. All this confirms the excellent generalization of Von Buch, that it *is the temperature of the summer months which determines the plane of perpetual snow.* It is thus easy to understand why the mean temperature of the snow line diminishes towards the Pole, because for a given mean temperature of the whole year the summer is far hotter in proportion. Also, places at which the temperature of the summer is low, are those which have a moderated or coast climate; but there also the fall of rain and snow is most abundant, whilst in excessive or continental climates the precipitations are comparatively small. The red lines on the small chart which indicate the mean temperature of July, have therefore a peculiar significance as respects perpetual snow; to take only one instance at present, they explain why in Iceland snow lies all the year at a height of only 3100 feet, whilst in Norway, on the same parallel, the snow line would approach 4000.

The same general principle holds good in the southern hemisphere. Its temperature, on the whole, being greatly inferior to that of the north (though the extremes are less), it acts towards the rest of the globe in some measure

as the refrigeratory of a great distilling apparatus (as some one has correctly observed), and its higher latitudes are the seat of almost continual storms and fog, of which the climate of Cape Horn is a familiar example. Summer there can hardly be said to exist, and the snow line is proportionally low. According to Sir James Ross,* the first living authority on the subject, the snow line *does* reach the level of the sea in the antarctic regions, at a latitude between 67° and 71°, under which forests still grow in Norway, and even corn in some sheltered places.

The following are the only estimates I have met with of the level of perpetual snow in Norway, although it is probable that others exist. We shall commence with the south-west district—

1. The Folgefond, on the south-west of the Hardanger country, is the most important of that region. An outlying hill (latitude 59°.9), above Rosendal, called Melderskin, is covered with perpetual snow (according to Hertzberg), though its height is only 4558 Rhenish, or about 4700 English feet. We may suppose the snow line to be at least 200 feet lower, as the summit is isolated, say 4500 feet.

2. Lat. 60°.1. On the western or seaward side of the Folgefond, near Moranger-fiord, by my observation (page 136), the snow begins at 3800 or 3900 English feet.†

3. Lat. 60°.1. The landward or eastern side of the Folgefond ceases to be covered with snow, according to the same authorities, at 1697 metres, or about 5240 English feet.

* From a private letter with which he kindly favoured me.

† This observation, though subject to some doubt, is well confirmed by the limit of the birch, as ascertained by Professor Christian Smith of Norway.

4. This last elevation, has been also determined by Naumann (Travels, i. 130), but with a very different result. The mean of two observations of 4100 and 3950 Rhenish feet, corresponds to 4150 English feet.

All the preceding determinations are subject to some doubt. In the first the *snow line* is not directly measured at all, only the summit of the hill. In the second the barometer was acting imperfectly. The third is unquestionably much too high from a comparison with the determined height of various parts of the 'fond' (see *Gæa Norvegica*, p. 159), certainly many hundred feet above the snow line. The fourth, on the other hand, is as certainly somewhat too low, the observation having been taken (Naumann, i. 109), at an outfall or depression of the glacier. It seems to me very probable that a mean of the whole will be tolerably correct, which gives nearly 4400 English feet.

5. Lat. 60°.2. Hartougen, in the Hardanger-field (Smith), 5000 Rh. ft. = 5150 Eng.—Lat. 61°. The interior range of the Fille-field (Von Buch), 1694 metres, about 5560 English feet. Mean 5400 Eng. feet.

6. Lat. 61°.5. Outlying portion of Justedals Bræen towards the sea, between Jolster and Indvigs-fiord, according to Naumann, about 4000 Rhenish, or 4120 English feet.

7. Lat. 61°.6. Justedals Bræen, east side, near Lodalskaabe (Von Buch and Bohr), mean 5460 English feet.

8. Lat. 61°.6. Storhougen, between Lyster and Justedal (Keilhau), 5000 French, or 5330 English feet.

9. Lat. 61°.6. In the centre of the chain, near Otta-vand (Broch), 4610 Rhenish, or 4750 English feet.

10. Lat. 62°.2. Dovre-field, according to Naumann, 5200 Rhenish, or 5360 English feet. Dovre-field, guessed by Von Buch at 1582 metres, or 5109 English feet.

11. Lat. 67°.1. Sulitelma, on the frontier of Norway, and Swedish Lapland. Wahlenberg is the sole authority. As reported by Von Buch, the snow line is at 1169 metres, or 3840 English feet; but there seems to be some mistake, for in Wahlenberg's *Flora Lapponica*, it is expressly said (Introd. p. xl.), that the summit of the mountain is 5796 French feet above the sea, and 2600 above the snow line, leaving, therefore, almost 3200 French feet for the height of the latter. Von Buch's 1169 metres* is equivalent to 3600 French feet. Wahlenberg, in another place, assigns 3300 French feet as the general height of the snow line in Lapland (p. xxxv.) M. Durocher gives 1169 metres as the height (always on Wahlenberg's authority) in the *Expedition du Nord*, and 1010 metres = 3109 French feet, in his paper in the *Annales des Mines* (1847, vol. xii. p. 79), which corresponds with none of the others. Under these circumstances, we must take Wahlenberg's own authority, and conclude that the level of the snow line at Sulitelma is probably—

On the west, or Norway side, 3200 French = 3410 English feet.
On the east, or Lapland side, 3300 French = 3520 English feet.

12. Lat. 70°. At Alten in Finmarken, which is somewhat removed from the immediate influence of the sea, the snow line is fixed by Von Buch at 1060 metres or 3480 feet. But this being an insulated summit (Storvands-field), is hardly comparable to Sulitelma, the greatest concentration

* See his Memoir on the Snow line in Norway, in the *Annales de Chimie*, already cited. It is an abstract of a larger essay to be found in the French translation by Eyries of his Journey in Norway, and in Gilbert's Annals for 1812. See also Thomson's Annals of Philosophy, vol. iii., for a translation.

of snowy mountains in the north of Scandinavia, and consequently colder in proportion.

13. Lat. 70°.4. On the island of Seiland, level of perpetual snow, according to Keilhau, 2880 Rhenish, or 2970 English feet; according to Durocher, 886 metres, or 2910 English feet—a close agreement.

We are at first surprised to find so few and little accordant determinations of the level of the snow line in Norway, but it is easily explained. In Norway (unlike Switzerland) the snowy regions are commonly remote from inhabited valleys; they are of difficult access, and are rarely and casually visited by the curious traveller. The ascertainment of permanent from occasional snow, always difficult, is nearly impracticable except by continued and close observation, and it is not to be expected that the natives should be able to give satisfactory information on a subject of so little interest to them.

The substance of the preceding observations may be reduced to this—

First. The first four and the 6th observations tell us that in lat. 60° to 62° the snow line at a short distance from the coast may be considered to be at 4300 English feet, or thereabouts.

Secondly. In the same latitude, towards the centre of the country, it rises (by the 5th, 7th, 8th, 9th, and 10th observations) to 5300 feet.

Thirdly. In lat. 67°, *in the interior*, it has fallen to 3500 feet, and is not much lower on *insulated* summits in lat. 70°, though on the coast it falls to 2900. This trifling effect of latitude is partly explained by the marked tendency of the summer isothermal lines to run parallel to the peninsula of Scandinavia.

Von Buch has remarked, that in Norway and Lapland the planes of vegetation of the pine and birch run nearly parallel to the plane of perpetual snow—the intervals, as observed by him at Alten, being given by the following table of limiting heights of vegetation above the sea—

VEGETATION IN LATITUDE 70°.

The Pine (*Pinus sylvestris*) ceases at . .	237 metres =	780 Eng. ft.
The Birch (*Betula alba*) ceases at . . .	482 metres =	1580 Eng. ft.
Bilberry (*Vaccinium Myrtillus*) ceases at .	620 metres =	2030 Eng. ft.
Mountain Willow (*Salix Mirsinites*) ceases at	656 metres =	2150 Eng. ft.
Dwarf Birch (*Betula Nava*) ceases at . .	836 metres =	2740 Eng. ft.
The Snow line	1060 metres =	3480 Eng. ft.

From the growth of the birch he has estimated the level of the snow line in the islands of Qualoe and Magerœ, though neither of these rise to the requisite limit. It is probable, however, that the direct sea blast to which those bare rocks are exposed, must act chemically upon vegetation in a way which would render the deduction of the snow line considerably doubtful—which doubt is confirmed by the more recent determination of the snow line on the island of Seiland, opposite to Qualoe. Still, as a guide to fill up the gaps of direct observation, I add some determinations of the limit-level of the common birch in Norway, chiefly taken from the *Gœa Norvegica*, from *Naumann's Travels*, and from the observations of Wahlenberg, and of Smith the Norwegian botanist. These are important, as indicating the *law* of the phenomenon. Von Buch estimates the interval between the limit of the birch and perpetual snow at about 1870 English feet throughout

Norway; Wahlenberg, at 1960 English feet; which probably represents best the results in higher latitudes. In the following table, I have inferred the height of the snow line from the limit of the birch, by adding 1900 feet to the latter number, and I have added in another column the direct determinations of the snow level previously given.

Places where the Superior Limit of the Birch has been observed.	Mean Limit of Birch in English ft.	Snow Line in English ft.	
		Inferred.	Observed.
Lat. 59½°. Gousta-field, Tellemarken (*inland*) 3500, 3290 Rhenish feet	3550	5450	
Lat. 59½°. Suledals-field, 3090, 2760 Rh. ft. (*coast*)	3010	4910	
Lat. 60°-61°. Hardanger-field, 3320, 3440 Rh. ft., Fille-field, 3300, 3630 Rh. ft. (*inland*)	3520	5420	5400
Lat. 60°. Hardanger-fiord, Ullensvang, 2900 Rh. ft., Folgefond, 1900, 2100, Voss, 2630 (*coast*)	2450	4350	4370
Lat. 62°. Lom, central chain, 3150 Rh. ft; Dovre, 3370, 3350, 3600, 3220; Roraas, 3400; mean, 3350 (*inland*)	3450	5350	5300
Lat. 64°. North Throndhjems Amt, seven observations, of which the highest is 2130 Rh. ft. on the Swedish frontier; the lowest 1790 Rh. ft. on the Börge-field; mean, 2000 almost exactly	2060	4110 *inland.* 3810 *coast.*	
Lat. 67°. Gilleskaal, Salten, near the sea, and also near great Icefields of Fondal, 1200 Rh. ft.; Stegen, 1320 (*coast*)	1300	3200	
Lat. 67°. Sulitelma, W. side 1100, E. side 2100 Fr. ft. (*inland*)	1710	3610	3460
Lat. 68°. Lofodden 1510,* 1070, 1030 Rh. ft.; mean (*coast*)	1200	3100	
Lat. 69½°. Alten, Finmarken, and *interior* generally, 1550, 1550, 1300, 1420, 1150; Kaafiord, 1530; mean 1420	1460	3360	3480
Lat. 70°.6. Qualoe, 227 metres (Seiland, snow line) (*coast*)	750	2650	2940
Lat. 71°.2. Mageroe, North Cape, 130 metres	430†		

* Lödingen, sheltered exposure, Von Buch.

† From excessive exposure not comparable to the others. The same remark applies in some degree to the preceding observation at Qualoe.

By means of a graphical construction, derived from the preceding table, I have succeeded better than I could have expected, in representing the variation of the snow line, and the limit of the birch in Norway, in terms of the latitude. But it is *absolutely necessary*, on the roughest estimate, to distinguish the Coast climate from the Inland climate. It appears on the slightest examination that the limit both of the birch and of perpetual snow rises as we recede from the coast towards the interior, the amount, however, varying between one latitude and another. By Coast, be it observed, I do not mean the actual shore exposed to the blast and spray of the open ocean, but generally (with some exceptions, however, as at Kaa-fiord, which has a continental climate), the comparatively narrow space where the mountains have a decided western declivity. The result of the projection (due regard being had to the number and worth of the observations upon which it is based) is, that the curves are nearly flat between 59° and 62°, where they begin to decline rather rapidly—passing from convex to concave about the 65th degree, from which point northwards they decline, but with extreme slowness. This form of the snow line is, I am persuaded, in the main correct. The rapid fall north of the Dovre-field, its flatness in the south, and its slow declivity in the north, all correspond to observation. I shall now give a table founded on these curves, for every two degrees of latitude.

TABLE OF THE HEIGHT OF THE SNOW LINE AND LIMIT OF THE COMMON BIRCH (*Betula Alba*) IN NORWAY.

Latitude North.	Snow Line.			Limit of Birch.		
	Interior.	Coast.	Difference.	Interior.	Coast.	Difference.
	Eng. Ft.	Eng. Ft.	Eng. Ft.	Eng. Ft.	Eng. Ft.	Eng. Ft.
60°	5500	4450	1050	3600	2650	950
62°	5200	4150	1050	3350	2450	900
64°	4200	3650	550	2300	1900	400
66°	3700	3250	450	1750	1450	300
68°	3450	3000	450	1500	1150	350
70°	3350	2900	450	1350	950	400

It will be understood that these numbers must be considered as mere approximations. Errors of from 100 to 200 feet may well occur in the best determinations of this kind. Besides, the distinction of Interior and Coast evidently does not admit of precision.

Beyond the limits of Norway the depression of the snow line is probably much more rapid. Over the ocean we come into wholly new climatic conditions. The level of the snow line at Cherry or Beeren Island, lat. 74½°, has been estimated at 180 metres, about 600 English feet, and at Spitzbergen, lat. 79½°, at 0; but I have already stated that this last result is inadmissible.

The preceding discussions establish completely the influence of climate in determining the rise of the snow plane towards the interior. This is most conspicuous about lat. 60° to 62°, where the difference, it would appear, amounts to perhaps 1000 feet; but rapidly declines in lat. 64°, corresponding, in fact, to the peculiar change in the form of the peninsula (referred to at page 190), which there rapidly loses its massive and elevated character, and the climate becomes in consequence more maritime. The rise of the

snow line may even be traced on the east and west side of the outlying mountains near the coast. It depends partly on the same cause as the rise of the snow line in the interior of Asia—the comparative dryness of the climate—but in great measure also on the greater effect towards the interior, of the solar rays; which at Bergen, and on the coast generally, are so often obscured by clouds and fog. Wahlenberg long ago remarked the superior importance of the heat of the sun in melting snow, compared to the effect of rain.* This is also true in Switzerland, though exceptions are sometimes striking.† But in Norway, the rain which falls on summer snow can have no great warmth, nor be in any great quantity. We shall probably much exaggerate its effect, if we suppose that one fourth of the yearly fall on the snow fields is in the state of rain, and that the mean temperature of that rain is 40° F. This quantity would thaw no more than *one fiftieth* of the snow fallen at other seasons.‡

We observe in passing, as the result of the comparison of the configuration of the country with the position of the snow line, that though the surface actually covered by perpetual snow in Norway be small, yet the mountainous districts and table-lands everywhere approach it so nearly,

* "Calore solis nix melius solvitur quam pluviis omnibus calidis;" and more to the same purpose.—*Flora Lapponica*, Introd. lvi.

† The floods of September 1852 at Chamouni, were caused mainly by a deluge of warm rain, which acted simultaneously on the glaciers and snows up even to the summit of Mont Blanc, which was seen all the while from Chamouni, whereas falling snow always conceals it more or less. My guide Auguste Balmat mentioned these facts to me in a recent letter.

‡ M. Durocher has computed, from the observations made at the convent of the Great St. Bernard in Switzerland, which is but little below the snow line, that not more than *one ninetieth* of the annual snow is dissolved by the rain.

that the snow plane may be said to *hover* over the peninsula, and any cause which should lower it even a little, would plunge a great part of the country under a mantle of frost. Nay, so nice is the adjustment, that even the convexity of the rocky contour has its counterpart in the fall of the snow line near the coast, and in the general depression towards the north. The incidence of this remark will presently be more fully perceived.

CHAPTER X.

ON SOME POINTS IN THE PHYSICAL GEOGRAPHY OF NORWAY,

CHIEFLY CONNECTED WITH ITS SNOW FIELDS AND GLACIERS.

Continued from Chapter IX.

§ 4. ESSAY TOWARDS AN ENUMERATION OF THE PRINCIPAL SNOW FIELDS AND GLACIERS OF NORWAY. § 5. THE GLACIERS OF NORWAY COMPARED WITH THOSE OF SWITZERLAND—ANALOGY PERFECT—DIFFERENCES LESS THAN MIGHT BE EXPECTED FROM DIFFERENCE IN LATITUDE—DUE CHIEFLY TO THE DIFFERENT RELIEF OF THE COUNTRY. § 6. ON THE FORMER EXTENSION OF GLACIERS IN NORWAY—MORAINES OF ANCIENT GLACIERS FIRST DESCRIBED BY ESMARK—SIMILAR TO THOSE OF SWITZERLAND AND OTHER COUNTRIES—CHANGE OF CLIMATE NECESSARY TO COVER NORWAY WITH SNOW AND ICE NOT EXCESSIVE. § 7. ON SOME OBSERVATIONS DESIRABLE TO BE MADE. § 8. ON SOME PECULIARITIES OF THE SCENERY OF NORWAY—WATERFALLS.

§ 4. *Essay towards an enumeration of the Principal Snow fields and Glaciers of Norway.*

THE existence of perpetual snow is not sufficient to produce a glacier. Of climatic conditions, extreme dryness and extreme cold are not favourable. Pallas affirms that Siberia is destitute of glaciers. In the tropical region of South America, if glaciers exist, they are certainly small, but they abound in the foggy and inhospitable coasts near Cape Horn. The climate of Norway is favourable in this

respect, but another condition is often wanting—a sufficient continuity of mass, and the disposition of snow in *basins*, affording a large feeding surface of *névé*, or compacted snow, from which the glacier, occupying the natural outlet of such a valley, takes its origin. A *calotte*, or convex surface of ice and snow, is not favourable to the production of a glacier. Isolated peaks are altogether unfavourable, and so are flat-topped hills of small extent.

The glaciers of Norway have excited but little notice. The allusion to them in Pontoppidan's work (though he professed to describe the chief curiosities of the mountains of the Bergen Stift) is extremely general. "In some places far north," he says, "the undermost layers of snow, by long lying, turn to a bluish ice, called in our language Iisbrede, which sometimes slide to a considerable distance over the lower grounds, to the no small detriment of the peasants."* He then refers to the descent of the glaciers of Justedal, which was then recent. The term *Iisbrede* means literally an *outspread of ice*, which is characteristic enough; and Iisbræer, which is the more common term, is perhaps a corruption of it. *Fond* or *Sneefond* signifies, I believe, any mass of perpetual snow. *Skavl* is a convex mass of snow of less extent, and *Skæker* a descending glacier.† In Lapland the latter is called *Geikna* or *Jegna*, and in many parts of Norway *Jökel* or *Jökull*, and *Falljökul*, which is, I believe, Icelandic.

The first who bestowed some attention on the glaciers of Scandinavia were Wahlenberg and Von Buch. These were the true De Saussures of the north. Wahlenberg in particular made three extended and most laborious journeys

* Natural History of Norway, p. 28. 1755.

† Munch in *Gœa*, p. 515, note.

through the wildest parts of Lapland, of which he has left but too short a record in his admirable introduction to the *Flora Lapponica*, and in his "Determinations of Height and Temperature in Lat. 67°."* To him we owe a detailed examination and description of the wild group of Sulitelma, in the manner of De Saussure's Travels in the Alps. Wahlenberg and Von Buch met in the course of one of their journeys, and no doubt, mutually increased their information. To the latter (jointly with his friend and companion Christian Smith, the botanist, who died in Africa), we owe many indications as to the snow fields of the west, unvisited by the Swedish naturalist. The published notices in Von Buch's Travels are unfortunately scanty, and do not include the Bergen Stift, which, notwithstanding, he had explored; and he probably left some scattered notices in the Norwegian periodicals referred by some later writers, but of which I have been unable to obtain a satisfactory account, though a friend at Christiania has taken some pains on purpose. But it appears incidentally, that he had explored the snow fields, both of Justedal and Folgefond, as he has given the height of the snow line in one place, and referred to the exact level reached by the glacier of Bondhuus in another.†

Haussmann, Clarke, and most later writers, scarcely touch on the subject of glaciers. Náumann and Durocher, however, have conveyed valuable and specific information, as well as Keilhau and Munch amongst native men of science.

* I do not overlook the interesting journals of Linnæus in his "*Lachesis Lapponica*;" but these are more exclusively botanical.

† I have reason, however, to think the paper referred to in the note to page 209 is his principal, if not only publication on the subject.

I do not pretend, in this first attempt, to enumerate the individual glaciers of Scandinavia, nor in the map accompanying this work (on which their positions are roughly indicated), either to define or give names to a great number of whose existence I have only been able to ascertain some traces, many of them by the indications given in Professor Munch's very valuable map of Norway, and by his private communications; nor do I profess to enumerate all the mere snow fields of this vast country, many of which have a doubtful character, the snow filling great hollows or flats all the year, whilst the summits rise black and nearly bare above them. There is so little inducement to penetrate these vast wildernesses of table-lands, and to ascertain where the snow disappears in summer, and where it does not, that it will require all the energy of native naturalists, for years to come, to fix these boundaries.

Lat. 59°.5. *Goustafield* in Tellemarken, well known to travellers who visit Kongsberg and the Rjukan Foss, rises to about 6200 English feet, therefore might be expected to be nearly 1000 feet above the probable snow line. It appears, however, that owing to its insulated position and rugged top, the snow has no definite inferior level, and occasionally the snow even disappears, which happened in 1852.

Lat. 59°.5. To the east of Suledal, not far from the west coast of Norway, is a mountain mass, which appears to exceed 5000 feet, and may therefore be presumed to reach the limit of perpetual snow near the coast. Naumann crossed a portion of this field from Vatendal to Suledal, but it is otherwise little known, and certainly bears no glaciers of magnitude. A little farther north is the Breifond, a *calotte*, or cap of perpetual snow.

Lat. 60°. The *Folgefond*, already frequently referred to, is the most important glacier-bearing snow-field in this part of Norway. It is a narrow range of flattish topped mountains, stretching out in an immense promontory into the Hardanger-fiord. According to the very coincident authority of Hertzberg, Smith, and Naumann, the highest portion of the "Fond," or snowy surface, falls short of 5300 Rhenish, or 5460 English feet, which seems irreconcilable with the statement already given on the authority of Hertzberg and Von Buch, placing the snow line only 220 feet lower. The dimensions of the snowy and icy surface are irreconcilable with the supposition of so small a height for its supply. The whole runs in a north and south direction, the snow and ice filling a sort of cavity along the top. There are several small outfalls of ice, constituting true glaciers, on the east side of which the principal is the glacier of Buer, which descends to 1000 feet (according to Captain Biddulph); another and smaller is near the hamlet of Moge, on the Sör-fiord. But the most majestic outlet by far of the icy surplus is on the south-west, forming the fine glacier of Bondhuus (page 133), which descends to within 1120 feet of the sea level. Wittich, in his account of the west of Norway, describes the Matre-fiord behind Rosendal, to the west of the Hardanger, as a terrific ravine closed at the head by a *glacier*, and though this was only on report, it appears to be confirmed by a reference in Von Buch's paper on the snow line.

Lat. 60°-61°. The *Hardanger-field*, of which the Folgefond is a sort of offset, is a flattish range of immense breadth, and attaining generally a height of 4000 feet above the sea, which renders it an irksome and even a dangerous task to cross, since it cannot be accomplished in one day. My

impression, on viewing the west side of the Hardanger-field from nearly the highest part of the Folgefond, was, that no true mass of united snow field was to be seen from thence. According, however, to the inquiries I have since made from the most competent authorities in Norway, it appears that there is a large tract of high ground covered with snow, which in general terms may be called "Storfond," stretching nearly parallel, and not unlike in shape, to the Folgefond, from which it is separated by the depression of the Sör-fiord and by the valley which continues it towards the south. This great "fond," including several lesser "fonds" with separate names on Munch's map, is in most seasons, at least, a continuous mass of snow, as Professor Munch himself assures me; and I have so represented it in the map in this volume; but no glaciers occur. The vast and often snowy wastes of the Hardanger-field to the east and south-east of this, do not for the most part rise anywhere above the snow line, which there probably exceeds 5000 feet; yet great tracts of unmelted snow often lie all summer, and sometimes descend even below the birch limit.* We must not be surprised to find a contrariety of statements on the subject, for no one dwells in this wilderness; and in different years the amount of casual snow varies remarkably with the season. In some years the passage of the Hardanger-field may be made with little interruption from snow; in others, the whole "field" will appear to be above the snow line.

In the Hallings Jökulen, not far from the most north-western part of the Hardanger-fiord (near the Vöring Foss), are three or four glaciers, probably of the second order (of

* Christian Smith. Compare Biddulph in Forrester's Norway, pp. 188-9, who supposes the snow line to be 4500 feet.

De Saussure), derived from a summit of 6400 feet.* The Hallingskarven to the east of this, are snow-covered, but do not, I believe, include glaciers. In the wild country between Eid-fiord on the Hardanger, and Urland on the Sogne-fiord, is a snow field, the Vosse Skavlen (6750 feet) with glaciers of the second order, some of which terminate in lakes, in which their fragments float as in the Aletsch-See in Switzerland.

The Fille-field in the same latitude has limited snow fields, but no glaciers.

Lat. 61° 5′. The Justedals Bræen are the most considerable snow fields in Norway, unless, perhaps, those of Fondal. The snowy range to which they belong, extends, probably, at least 50 English miles in a N.E. and S.W. direction, of which the Lodals Kaabe, or Mantle of Lodal, is the highest part. On the southern declivity we have the two great glaciers of Fjærland,† and one or more at the head of the Veitestrands Vand near Sogndal;‡ the glaciers of Kron or Berset; and the proper glaciers of

* The glaciers represented on the south slope of the Jökulen on Munch's map are inserted from a competent local authority. "In warm summers," writes Captain Vibe, "the Jökul is seen as a whole mass of ice traversed by crevasses."

† In addition to what has been said of these at page 150, Krafft in his *Beskrivelse over Norge* gives the following information:—The glacier mentioned as occupying the *head* of the Suphelle Valley (and which is called Vesle or Little Glacier) is estimated at half a Norwegian mile in length, and from 1500 to 2000 paces broad; the Suphelle-Bræ, at 5000 paces long, and 1800 broad; Boiums-Bræ is three eighths of a Norwegian mile long. There are also considerable glaciers at the head of the Veste-fiord (a branch of that of Fjærland), which have likewise retreated from their moraines.

‡ This glacier is said to reach the level of the lake. It and another called Tunsbergs-Bræ, on the side towards the Lyster-fiord, descend from the portion of the snow-field called Hesten (the Horse).

Justedal, viz., Nygaard, Faabergstol or Biörnesteg, Trangedal and Lodal. All these are glaciers of the first order descending into the valley. Of these, according to Durocher, the glacier of Lodal is the largest, not only in Justedal, but in Norway—its estimated length being 9 kilometres, or 5½ miles, and its greatest breadth 700 to 800 metres, or above 800 yards. I should suppose that these numbers are merely estimations. The glacier of Nygaard, with a course of less than four miles, has a breadth of 1000 or 1100 yards, according to the same author. The inferior levels of these glaciers are, Berset, (page 165) 1317 feet, but 1590 according to Von Buch; Nygaard, 1815; Faabergstol, 1360 according to Bohr, but 1570 according to Naumann; Lodal and Trangedal, 1770 (Bohr), or 1890 (Naumann).* The north-west or seaward side of the Justedal range is difficult of access, and very little frequented; but it may be supposed that the glaciers are extensive, the snow line being there remarkably low. On Munch's map, two are conspicuously indicated, one in the prolongation of the Bredheims Vand, which is nearly opposite to Sogndal, on the opposite side, and one at Brigsdal, near Indviken, on the Indvik-fiord, which is nearly opposite to the Krondal. The latter, Professor Munch informs me, approaches within 2000 feet of the cultivated fields. But neither he nor perhaps any naturalist of Norway has visited this region.

Nearly on the same parallel with Justedal is the extensive Sogne-field, including the Ymes-field, rising to 8450

* After crossing the col which separates Justedal from the valleys connected with Gulbrandsdal and Lom, we find first the Musubytte-Bræ in the Brendendal and two glaciers in the Randal, called Randals and Tverbötte-Bræ.—*Krafft.*



MAP OF THE GLACIERS OF THE YMESFIELD

in lat. 60° 40'.

feet, but the elevation being abrupt and not disposed so as to collect snow in the interstices, the glaciers, though numerous, are not very great in extent. A gentleman, well acquainted with this country, informed me that the principal glaciers are the Smörstab Bræen, to the west of the Ymes-field, and again those in Lærdal, which descend from the Galdhöppigen. It may be useful to tourists to know that it is practicable to go from Lom to the *sæters* (or châlets) in Vissdal, and thence by Leer Vand to Utledal and Aardal on the Sogne-fiord. I am enabled by the courtesy of Professor Munch to append a map on a considerable scale of the glaciers of this remarkable region. It is reduced from an original drawing by the engineer who surveyed it, and which has been put at my disposal.

Almost connected with the Ymes-field are the Glittertinderne (8100 feet) and the lofty mountains of Lom, which, in the panorama of Sneehättan, show by far the most conspicuous snow fields. They unquestionably include glaciers of the second, probably also of the first order, and some of these Captain Vibe states (in a private communication) are accompanied with conspicuous moraines, which, however, are often in inverse proportion to the dimension of the glacier. They are also described by Esmark.

The group of the Trolltinder near Romsdal, considerably farther north, is said by Wittich to include at least one glacier of large size.*

Lat. 62°.3. Sneehättan (7520 feet) gives birth to an inconsiderable glacier terminating in a small lake. It is situated at the bottom of a precipice, which extends from Sneehättan towards Skreahög. I am not aware that any other glacier has been described in the wide expanse of

* Visit to the Western Coast of Norway, p. 146.

the Dovre-field, which is, however, confessedly unexplored to the westward, it being doubtful whether Skreahög and even other summits may not equal or exceed the height of Sneehättan.* The striking group of the Rundane, which belong to the south-west of the field, though very lofty, harbour but little snow; and, I was assured on good authority, contain no glacier. Even in the very commencement of July, when I ascended Sneehättan, and the winter snow was very far from having retreated to its limit, it was already quite above the general level of the "field," which was perfectly bare, as well as all the eminences of moderate height. The snow line is here as high as in any part of Norway—probably exceeding 5300 feet, and the portion of the surface which rises above this is trifling in extent. Snow fields, however, there are, not only between Sneehättan and the sea, but also between the rivers Driva and Orkla on the north declivity. These are somewhat conjecturally indicated on the map.† Towards the Swedish frontier, east of the Dovre, though the extreme heights exceed 5000 feet, they are limited in extent, and hardly any except the Syl-field attain 6000. Large snow fields are therefore not to be looked for.

Lat. 65°.3. The Börge-field, about 40 miles inland, and not far from the Swedish frontier, is described as being extensively covered with perpetual snow, and probably containing glaciers. The rivers Namsen and Vefsen, well

* Gæa Norvegica, p. 514. The following summits have been named to me as rising above the snow line:—Naadalstinderne, Styggvaa, Storehö, Midhö, Svarthö, and Bratfonden. But this is, emphatically, "the least known part of Norway."

† They are more extensive than is usually supposed. According to Professor Keilhau (by whom alone they have been visited), the Kamban and Troldhätta, which are 6000 or 7000 feet high, include small glaciers.

known to anglers—the former running towards the S.W., the latter to the N.W.—take their rise on opposite sides of this mountain mass, of which the culminating point, called Voùenjal'olki, is probably much above 4000 feet, as a considerable part of the field certainly attains that height.

Lat. 66°.3. Junkaren Soupts (*Soupts*, in the language of Umean Lapland, signifies a glacier) is a snow field and glacier of limited extent, the latter descending to the small lake of Virihjaur, whose waters run to the Bothnian Gulf. It is mentioned only by Wahlenberg.

Lat. 66°–67°. The Fondalen, a range of glacier-bearing mountains, of which the effect, as seen from the sea, has been described at page 52. They appear to be the most important which occur to the north of Justedal, with, perhaps, the exception of Sulitelma. They are described by Professor Munch* as extending from Bejern to Ranen, or through 50′ of latitude, with a breadth of from 2 to 4 Norsk (14 to 28 English) miles, and as sending glaciers *into* the sea at Holands-fiord (near Fondal) and in the Melfiord (which is some miles farther south). The descent of the glaciers to the very shore is referred to both by Wahlenberg† and Von Buch,‡ although it does not clearly

* Gæa Norvegica, p. 512.

† "Glacies ad littora maris descendit." Wahl. Flora. Introd. xli.

‡ "About four or five English miles south from the Cape, opposite the trading station of Haasvär, a glacier descends from the height, and the ice comes into immediate contact with the sea, a circumstance perhaps peculiar to this glacier. Even then the warmth of summer had drawn it a few steps from the shore, but it would probably regain its former space in a short time."—Black's Translation. 4to, p. 152. The last sentence would seem to infer Von Buch's actual visit to the glacier; yet I apprehend that the information was more probably derived from the persons with whom he lodged at Swinvär or Viigtil, for neither the dates in his journal, nor the track indicated on his chart, appear to allow for an excursion to Fondal itself.

appear that either of those eminent naturalists visited the spot. Both these authorities call the ice mountains Kunnen, which properly is the name of the headland described at page 53. In the same latitude with Cape Kunnen, but in the interior, is an isolated snow-field called Saulotjack, which, however, yields no glacier.*

Lat. 70°.1. Sulitelma, the highest mountain within the Arctic Circle, situated about fifty miles inland on the frontier between Norway and Lulean Lapland, is connected with extensive snowy ranges and large glaciers. It would be worthy of notice, if only from the pains bestowed on the illustration of it by the philosophic Wahlenberg. It is nearly half a century since this eminent physical geographer investigated the glaciers of Sulitelma in a manner which had not been done in any other place, save the vicinity of Mont Blanc, and which has not yet been done for the far more accessible, and not less interesting snow fields and glaciers of southern Norway. The eminent naturalists of that interesting country will not, I hope, delay longer to investigate all the par-

* Since the above was written, I have received important unpublished information from Professor Munch, regarding the glaciers of Fondal. The outline of the snow field has been indicated on the map as correctly as the scale admits of. On the seaward side we have a glacier of the first order, descending to the Nord-fiord, a small branch of the Mel-fiord; three others descend to the Holands-fiord, which is the innermost part of the Skars-fiord. The snow field extends to within a short distance of Bejern, on the 67th parallel. On the *landward* side we have (probably) a glacier called Hatvisvagge Jækna, in lat. 66° 47′. The eastern boundary of the snow field touches Storm-vand and Eiter-vand; and farther south, a considerable glacier descends to the Svartiis lake, which it partly fills. This is in the neighbourhood of the Ranen-fiord. Any one intending to explore these glaciers, should provide himself with Professor Munch's lately published Map of *Northern* Norway, where all these names will be found.

ticulars connected with these phenomena, which the passing stranger dares only guess at. In 1807, Wahlenberg passed several weeks under a tent at the large lake Virihjaur, which lies close under the eastern declivity of the range of Sulitelma, and at 1900 English feet above the level of the sea. This he describes as the centre of the Lapland Alps; and from it he made numerous excursions, exploring the range of Sulitelma, ascending its highest point on the 15th July, which he found to be 5796 French, or nearly 6200 English feet, and minutely examined its glaciers. The results were published in a thin quarto volume at Stockholm in 1808, of which I give the exact title in a note.* I have been able to meet with no copy of a German translation by Hausmann. I have, however, ascertained the general scope of the work, which contains a careful engraving of the glacier of Salajegna, and a most excellent map. It is evident that Wahlenberg was well acquainted with De Saussure's classification of glaciers in the Alps.† The *range* of Sulitelma has a height of 4600 French feet, and is extensive. The height of the north or highest summit has been just given, the south top is 5173 French feet, and it is between the two that the glacier in question takes its rise, descending towards the lake of Pieskijaur on the south. It is of great width,

* G. Wahlenberg, Berättelse om Mätningar Og Observationer för att bestämma Lappska Fjällens Höjd och Temperatur vid 67 Graders Polhöjd. Stockholm 1808. 4to, 58 pages, map and 3 plates. The German translation was printed in 1812.

† In one or two instances, however, he inadvertently reverses the well-known definition of glaciers of the first and second order; as when he terms the Salajegna as one of the second order, describing it, however, clearly in detail as one of the first, viz., extending far below the snow line.—*Flora Lapp.* Introd. p. xxxvi.

and appears not to have a long course. Durocher states the inferior level of the glacier (of course on the authority of Wahlenberg, who alone has visited it) to be 780 metres, or 2550 feet; therefore, nearly 1000 feet below the snow line on the Lapland side.

Of the group of Sulitelma is the summit of Ålmajalos, 5200 French feet high, and bearing at least two glaciers, Ålmajalos-jegna and Lina-jegna—the former on the north, the latter on the south side. Its prolongation on the Norwegian side is called Blaamands-field, and is that represented in the woodcut, page 56, as seen from Bodö. A little farther north (lat. 67°.3) is the flat-topped Tulpajegna, rising to only 4000 English feet. It possesses only small glaciers terminating at a high level.*

Lat. 68°. About this latitude are four detached summits of the main chain covered with perpetual snow, but, so far as is known, not connected with glaciers. They bear the names of Getsetjack, Pernitjack, Midatjack, and Altekaisse, and are inserted in the map on Wahlenberg's authority.

Lat. 68°.2. The Lofodden range of islands attains the snow line at least in three places, in Vest Vaagen, Ost Vaagen, and Hindö. The wild snowy mountain peaks of the second are shown in the view of the Svart-fiord, Plate III., but it is evident that in such a country the snow cannot accumulate; in Hindö a glacier mentioned by Von Buch descends from the Fisketind.

Lat. 68°.9. Andorgö, at the north end, a small well characterized glacier of the second order.

* Erroneously called of the first order in the same page of Wahlenberg's *Flora*. The glaciers of Ålmajalos are apparently of the first order.

Lat. 69°.4. Bensjordstind, a considerable glacier, though probably not overpassing the snow line. See page 67.

Lat 69°.7. The promontory of Lyngen, which includes the highest land of the far north, has a considerable snow field, which sends down true glaciers of the first order on both sides. On the west, or towards Ulfs-fiord, we have the Jägersvand glacier; on the east, or towards Lyngen-fiord, there are the glaciers of Pippertind, Reendal, and probably another.

Lat. 69°.9. In the island of Ringvadsö a small glacier occupies the hollow of a mountain at a considerable height, which has formerly been much larger, and has pushed its moraine to the water's edge. See page 74.

Lat 70°.0. On the island of Kaagen, the well defined glacier represented in the wood engraving, page 77.

The Qvenanger Tinderne probably send down a glacier towards the fiord of the same name.

Lat. 70°.2. The Jökuls-field, a snow-covered promontory of very considerable extent, sends down glaciers on at least three sides, and all approach nearly to the level of the sea. That in the small Jökuls-fiord is actually bathed by the sea, and projects over it like the glaciers of Spitzbergen. The Bergs-fiord on the north includes at least one fine glacier. The glaciers of the Nus-fiord on the east are represented in Plate V. These are the northernmost glaciers on the continent of Europe which descend below the snow line.†

* The indication on the map is not worthy of confidence as shewing the true locality. It was described to me by Consul Crowe of Christiania, as descending on the north side of the Logsund, a ramification of the Qvenanger fiord, which will be found on the sea charts, but not on any map which I have now within reach.

† There is a small one, I believe, referred to by Everest, in connection with the perpetual snow of the island of Seiland, in lat. 70°.4.

Only one or two summits near Alten attain the snow line, and the hills being lower in the interior of Finmarken than on the coast, at the same time that the snow line is higher, perpetual snow may be said to be entirely unknown there, as well as at the North Cape, in Finland, and in Russia in Europe.

§ 5. *The Glaciers of Norway compared to those of Switzerland.*

The forms of the Norwegian mountains contrasted with the Alps have been aptly enough compared by Wittich—the former to the embrasures of a parapet,  the latter to a ridge-and-furrow roof,  the depressions in the former representing the profound gorges which intersect the rocky plateaux; in the latter the usual alternation of mountain and valley. When such mountains are covered with snow, the difference of effect is manifest; in the former it spreads over vast table-lands with tolerable uniformity, or melts in the profound intersections; in the latter it drifts and slides into valleys of great elevation, and by accumulation it forms glaciers. The glaciers of Norway are not therefore so large as might be expected, or at least there are but two or three large ones in the whole country, and these are of an order inferior to such great glaciers as the Aar, Aletsch, and Mer de Glace of Chamouni. The largest glacier in Norway (Lodal) may be rudely estimated to have only *one-seventh* of the surface of the Aletch glacier, tributaries in both cases being excluded; but the snow field connected with it may cover 400 English square miles at least, which probably exceeds in extent

anything in the Alps. The perpetual snows of the Fondalen are much larger, and those of Sulitelma not inferior.

It results from all the observations which I was able to make in Norway (and there is that in the *physiognomy* of glaciers which enables us to form a tolerably just opinion regarding even those which I did not actually walk over), that the conditions and structure of the Norwegian glaciers are almost identical with those of Switzerland, with the exception merely of the table-like forms of the snows with which they are connected.* Even the climatic influences have much in common. The elevation of the Alpine valleys produces an effect analogous in many respects to the higher latitude of Norway. The intense heat of the summer days in both situations is notorious, aided in the one case (Norway) by the almost constant sunshine; in the other (Switzerland) by the influence of height in increasing its intensity.† The cold of winter is exaggerated in a similar manner in both situations. The fall of rain is no doubt very great in Norway, from its exposure to the Atlantic; but the enormous mass of the Alps favours the formation of cloud to such an extent as nearly to compensate this. Whilst the plains of Switzerland and Piedmont have but 30 or 35 inches of rain annually, there falls at the Great St. Bernard (8000 feet,

* Such glaciers, for instance, as the Folgefond, are not known in the Alps.

† This is not a theoretical result merely. It results from the experiments which I made in 1832, with the assistance of Mr. Kämtz, that the radiant heat of a summer day is far more intense about the level of the snow line than in the valleys. The direct influence of the sun-heat absorbed by the snow, which it melts, is to be carefully distinguished from its comparatively feeble effect in warming the air, which, taking place principally by the contact with heated soil, is ineffectual when the air reposes on snow at 32°.

chiefly of course in the form of snow) nearly 60, and in the south-eastern Alps the fall of rain quite equals that at Bergen. Many persons will be surprised to learn that at Tolmezzo, only 1000 feet above the sea, 90 inches of rain fall.* From these *data* we can perceive the strong analogy which prevails between Norway and the Alps. The chief difference is no doubt to be found in the shortness and greater comparative intensity of the summer heat in the north.

Every thing which I saw in Norway tends to confirm the theory of the cause of the motion of the glaciers, expounded by me some years ago, as well as the facts on which that theory was chiefly based. The leading facts attempted to be established in my former work on this subject,† as results of observation, are these:—1. That the downward motion of the ice from the mountains towards the valleys is a continuous and regular motion, going on day and night without starts or stops. 2. That it occurs in winter as well as in summer, though less in amount. 3. That it varies at all times, with the temperature, being less in cold than in hot weather. 4. That rain and melting snow tends to accelerate the glacier motion. 5. That the *centre* of the glacier moves faster than the sides, as is the case in a river. 6. The *surface* of the glacier moves faster than the bottom, also as in a river. 7. The glacier moves fastest (*other things being supposed alike*) on steep inclinations. 8. The motion of a glacier is not prevented, nor its continuity hindered, by contractions of the rocky channel in which it moves, nor by the inequalities of its bed. 9. The crevasses are for

* Average of 25 years. In 1806, 151 inches fell. See Schouw's admirable work on the climate of Italy. Suppl. p. 216.

† Travels in the Alps of Savoy, &c., particularly chap. xxi.

the most part formed anew annually—the old ones disappearing by the *collapse* of the ice during and after the hot season.

These well established facts give rise to certain peculiarities in the form and appearance of glaciers, which are easily recognised by one accustomed to such observations, but on which we cannot now dwell. All of these I have observed on one or other of the Norwegian glaciers.

I conclude, therefore, that the differences are slight and immaterial between the glaciers of central Europe and those of Scandinavia. The theory of their motion, which I have deduced from the facts above stated or referred to, is this:—That a glacier is a plastic mass impelled by gravity, having tenacity sufficient to mould itself upon the obstacles which it encounters, and to permit one portion to slide past another without fracture, except when the forces are so violent as to produce discontinuity in the form of a crevasse, or more generally of a bruised condition of the mass so acted on;—that, in consequence, the motion of such a mass on a great scale resembles that of a river, allowance being made for almost incomparably greater viscosity,—hence the retardation of the sides and bottom: Finally, that diminution of temperature, diminishing the plasticity of the ice and also the hydrostatic pressure of the water which fills every pore in summer, retards its motion, whilst warmth and wet produce a contrary effect. These are the opinions which I laid down in 1842, and which ten years' experience and consideration have only tended to confirm.

In one instance only have I been able to infer the probable annual progress of the ice of a Norwegian glacier. This was in the Krondal glacier, of which, by means of the intervals of the "dirt bands," I estimated the annual progress at

168 feet. It appeared to me to be pretty much what I should have expected in Switzerland in a similar situation. I conclude, on the whole, that the plasticity of the Norwegian glaciers is greater in summer than in those of the Alps, and also that their season of rapid motion is probably shorter, which will compensate on the whole for its greater swiftness. This might be also inferred from the fact, that so long as the day is perpetual, or nearly so, the long diurnal pause in the liquefying process which produces so marked and impressive an effect towards sunset on the Swiss glaciers* scarcely occurs; thaw is or may be almost continuous; the ice is dissolving unintermittedly for weeks together. This also produces an excessive amount of melting snow during the 24 hours, part of which goes to lubricate and saturate the glacier. It is easy to see how effectual such a *continuous* action must be in softening the ice, compared to an intermitting one. Again, the shortness of the arctic summer is well known: six weeks of fine weather is a fair allowance. Consequently the season of greatest plasticity is as short as it is intense; the growth of the glacier may be compared to the growth of the luxuriant herbage. Consequently a long winter of *comparative* immobility fills up most of the year.

This, I say, might have been inferred beforehand; but my observations, so far as they go, lead to the same conclusions. I may mention, as a striking though incidental illustration, the beautiful little glacier of Kaagen, in lat. 70° (see the Figure, page 77) in which the form of a *trickling tear* is so well exhibited as to present strikingly a "collective instance"† of the plastic theory, bearing evi-

* See Travels in the Alps, p. 21.

† Bacon. Compare Herschel, Discourse on Nat. Phil. Art. 194.

dence in its mere aspect, of the ductility and tenacity of the gravid drop. I might indeed affirm that a glance at this one phenomenon from the deck of the steamer would have satisfied me, had other proof been wanting, that the consistence and mode of progression of a glacier is the same in latitude 70° as in latitude 45°. The remarkable state of collapse and reconsolidation of the crevasses which I observed on the remarkably crystalline and firm ice of the Nygaard glacier early in the month of August, is a similar example.

§ 6. *On the former Extension of Glaciers in Norway.*

Whilst the courageous Venetz was maintaining in Switzerland, single-handed and without sympathy, the bold theory of the former wide extension and geological activity of the Alpine glaciers,* a Scandinavian naturalist, Professor Esmark of Christiania, was drawing similar conclusions from the facts which his own country placed before him. There is no reason to suppose—but the contrary—that he knew of Venetz's paper, contained in a volume of scientific transactions of not the widest circulation; but he was led to speculate upon the former great extension of ice and snow in Norway, from facts precisely parallel and equally paradoxical with those which awakened the attention of Venetz, and had already prompted the happy forethought of Playfair and Hall,† the occurrence, namely, of enormous angular blocks of primitive rock, deposited on the flat southern shores of the Baltic, exactly as on the summits of

* See my travels in the Alps of Savoy, chap. iii.

† Ibid. p. 41, and Sir James Hall's papers in the Edin. Transactions.

the Jura hills are to be found the wrecks of the central chain of Alps.

The observations of Esmark having been published in the Danish language in a local periodical work, and, though they found their way into one British journal,* being little known, I shall quote a few sentences from them to show the clear opinions held by the author, and the resemblance of his conclusions to those which have been since broached as new. Their date, as will be seen, extends back at least to 1823.

Esmark observes, "In no other satisfactory way than by the operation of ice can we explain how those prodigiously large loose stones, sometimes with sharp corners, have been brought up to the ridges and tops of high mountains, which are found in such numbers in the province of Christiansand." He adds, that the nature of the boulders being quite different from that of the adjoining rocks, they must have been brought from a great distance and "pushed high up on the mountains."† . . . . "In travelling over our mountainous districts, especially towards Osterdal, it will frequently be found that the slope of the mountain towards the valley is covered with large loose stones, mixed with a great quantity of loose sand and gravel, and that this covering extends to a considerable height over the bottom of the valley." . . . . "We find the large stones lying separated from one another, surrounded by sand and gravel, a circumstance which cannot be explained in another way than by supposing that the whole has formerly been filled up with ice, which has pushed the whole mixed mass

* Edinburgh New Philosophical Journal, vol. iii. (1827.) Esmark on the Geological history of the Earth.

† This expression is only applicable to a glacier, not to rafts of ice.

up the slope of the mountain. The water of the ice, afterwards thawing, carried off by its rapid streams a part of the stones and gravel, which were then heaped together, deeper down in the valley; these heaps resemble entirely those which glaciers carry before them."

Perhaps the most curious passage relates to Esmark's observations in 1823 between Fossand and Vasbotten, situated, the former on the Hole-fiord, 14 English miles in a straight line, E.S.E. (by Munch's map) from Stavanger, on the west coast of Norway. After describing the character of the valley, he proceeds—"At the upper end, this sandy plain was bounded by a glacier dyke or rampart, which extended across the whole valley. This glacier dyke is remarkable, and, so far as I know, the only one of its kind lying close to the level of the sea, in a district where you find only a few heaps of perpetual snow in hollows of the mountains where it slopes to the north-east, at the height of from 2000 to 3000 Rhenish feet above the sea. Its length, across the valley from mountain to mountain, is 2250 feet; its perpendicular height above the plain 100. . . . . The dyke itself consists of coarse gravel and sand, mixed with immense blocks of gneiss, which is the prevailing rock in the mountain. . . . . Not only the dyke itself, but the whole horizontal surface exhibits proofs that there has been a glacier here, for the plain exactly resembles those which I found adjoining the glaciers presently existing between Sönd-fiord and Lomb, in Guldbrandsdal, where I had likewise occasion to travel last summer. The resemblance is so striking, that every one who has had an opportunity of making the comparison must form the same opinion."

An extract has already been given (page 103, *note*) from a farther portion of this paper of Esmark, in which he as-

cribes the fluting of the rocks near the entrance of the Sogne-fiord to an immense glacier.

The analogy of these observations, especially of the moraine of Vasbotten, to corresponding facts in the British isles, particularly in Skye and North Wales, which are now unhesitatingly ascribed to ancient glaciers, must be very striking to those who have attended to the recent progress of opinion on this subject. It can hardly be doubted, that every part of Europe, nay, the greater part of the world, affords similar indications. In the Himalayas, where the interesting researches of Vigne, Strachey, and Thomson have established the existence of glaciers of enormous dimensions, whose motions appear to be regulated by the very same laws as those of Switzerland and Savoy, we have also sufficient testimony of a former much wider extension, although the degree of that extension may still remain a matter of doubt. The existence of terminal moraines, like that above described, is clearly explicable on no theory yet defined, save that of glaciers; ice rafts could have no tendency to produce such an effect.

I have no intention of entering into the question whether *all* the grooved, fluted, and striated rocks in Scandinavia can be explained by the existence of a "*calotte*" or covering of ice, enveloping the mainland, and sending off glaciers dipping into the sea, and furnishing icebergs loaded with the blocks of their moraines, which were ultimately diffused and wrecked on the shores of Denmark, North Prussia, and even England. This would lead me to a dissertation, for the extent of which my own inconsiderable observations on the subject could afford no apology. It is impossible to read what has been stated for and against the supposition or hypothesis in question, without feeling

that arguments have been raised in its favour, and met by counter assertions, each of which show more zeal than knowledge. In truth, it has become far too much of a party question. Whilst I think it quite impossible to deny the existence of vast glaciers, both in Norway and elsewhere, producing the effects which have been ascribed to them by Esmark, and many of those noticed by Mr. R. Chambers and by myself, I hesitate to ascribe *every thing* to the same cause. In fact, there appear to me to be situations along the coast of Norway where abrasion is most manifest (for one example, the Logsund near the Hardangerfiord), where the action is *parallel* to the line of coast, and the movement of a glacier would consequently be inconceivable. The general parallelism of the *striæ*, observed by Böthlink and others over a large area of country, not co-incident with the general fall of the ground, would seem, if confirmed, to be equally inexplicable on the pure glacier hypothesis. The continuation of the striæ across tablelands and over *cols* is of the like ambiguous character.* I have never hesitated to express, on similar grounds, doubts as to the *universal* application of the usual glacier theory to the phenomena of our own islands, which, on a small scale, are the counterpart of those of Norway. For, though I am perfectly satisfied that our hills were in former times the seat of glaciers, which even approached the sea level, I find the utmost difficulty in explaining by such an hypo-

* Mr. Chambers describes especially the singular appearance of the country about the summit level between Throndhjem and Sundsvall on the Bothnian Gulf, which, at 2000 feet above the sea, tolerably level, is smoothed and polished all over with fine striæ, running N.E. and S.W. obliquely across the direction of the main water-courses.—*Tracings of the North of Europe*, p. 234.

thesis *alone*, the facts which occur even in the immediate vicinity of Edinburgh.

On the other hand, I will state some considerations which seem to lessen or remove difficulties which have been urged against the opinion that Norway was once *nearly* covered by snow and ice. That this was really the case is, I think, rendered probable by the facts so well described by Esmark, as well as by the grooving and polishing of the valleys connected with the great plateaux in the direction of their declivities (as in the valleys of the Driva and of Justedal), and by the evidence for a limit to the height of the abrading action, which lowers as we approach the coast, and is marked by the contrast of the *roches moutonnées* below, with the rugged peaks which rise over them. (See the view of the rocks of Folden-fiord, Plate II.) To these may be added the existence of moraines, especially *terminal* moraines; and, though I speak conjecturally, I have little doubt that the *terraces*, which are well known to exist in Sweden and Lapland between the Kjölen range and the Gulf of Bothnia, are due, in some degree at least, to the continuous moraines of ancient glaciers descending on that side from mountains still partially covered with perpetual snow. Such moraines almost invariably produce lakes; and it is well known that a chain of lakes at nearly equal heights above the sea interrupt the courses of the numerous rivers of that wide and desolate country. I repeat, however, that this is only a conjecture.

The main argument against the former extension of glaciers has been the great change of climate, which has been considered necessary to account for it. It has been usual to calculate the fall of mean temperature required in any latitude to bring the glaciers to the level of the sea, by supposing

that each degree (of Fahrenheit) of depression will lower the snow line by about 300 feet. Consequently, it is argued—to have glaciers at the level of the sea in the south of Norway, the snow line must be lowered 5500 feet, corresponding to some 18° of Fahrenheit—a prodigious change. But the principle is incorrect. It is on the summer temperature mainly that the position of the snow line depends. It is exceedingly probable that a diminution of the temperature of the summer months by 4° only would at once place *one-fourth* of the surface of Norway within the snow line; and so vast a mass of perpetual snow would refrigerate the climate (especially the summer temperature) to such a degree as would unquestionably pour glaciers into the head of every fiord in western Norway. In a former page* I have shown the singular manner in which the surface of the high ground of Norway is everywhere almost parallel to the snow plane, which, by a very slight depression, would cover all its table-lands; and I have also referred to the peculiarity of the climate of Iceland, where snow lies in lat. 65° at only 940 metres or less than 3100 feet above the sea; whilst in the same latitude the snow line in Norway is at 3900 feet, and even on the coast 3500.† Yet the mean temperature of Reikiavig in Iceland is very little short of

* P. 215.

† The snow line in Iceland is given on the authority of Durocher, by whose calculation (with which, however, I do not agree) it is no less than 477 metres, or above 1560 Eng. feet, below the height due to the latitude.—*Voyage en Scandinavie, Geog. Phys.* p. 311. Wahlenberg places it far lower,—viz., at 2100 French feet, if I understand him correctly.—*Berättelse*, &c., p. 49. In Dr. Rink's paper on the Continental Ice of Greenland, lately communicated to the Royal Geographical Society, it is stated that the snow line on the eastern coast of Baffin's Bay, between lat. 68° and 74°, may be stated to occur, on an average, at somewhat more than 2000 feet above the sea. The climate is more continental than that of Iceland.

that of Throndhjem in Norway, which has besides a somewhat lower latitude, and is many degrees superior to that of the Swedish side of the peninsula on the same parallel. We have only therefore to suppose that the climate of Norway has become more insular and less continental —that the summers are colder, the winters milder than formerly—in order to account for an almost indefinite extension of snow, and the possibility of abundant glaciers on its coasts *wherever the form of the valleys encourages their formation, and wherever the declivity of the ground is sufficient to allow the plastic development of the ice.* An example in an extreme case will show the immense influence of *the seasons.* The mean temperature of the North Cape is known to be nearly 32° of Fahrenheit (which at one time was imagined to be that of the North Pole itself). If the difference of summer and winter were insensible, it is manifest that the snow line would be at the surface of the sea; but it is (theoretically) still 2800 feet high (page 214), consequently the extreme effect of season alone here amounts to that quantity. But farther, a diminution of the extremes of temperature would, in the first place, be most likely accompanied by an increased fall of rain and snow; in the next place, the lowering of the snow line over so large a surface would deteriorate the climate and lower the mean temperature, which would thus lower the snow line still further; lastly, the theory of ice rafts, diluvial currents, &c., all presuppose a relative change of the level of land and sea, tending to render the climate more insular than at present, as the glacial theory requires, in fact, to make Scandinavia an island altogether.

Yet even when all of these accommodations are admitted, it is much easier to propose difficulties than to answer

them. All that I contend for is the extreme probability of a much more extended covering of snow and ice both in Scandinavia and elsewhere; but above all other countries in Norway, where, from the causes explained, a very slight disturbance of temperature would produce an almost incredible change in its climate, and would render it nearly uninhabitable.

It is one result of the progress of science to show the nice adjustments upon which the stability of the existing order of events depends. It is no longer necessary to invoke violent displacements of the earth's axis, or the atmosphere of a comet's tail, to alter our climates, and desolate our continents. The submergence of Europe to a small extent in the ocean, a diversion of the great oceanic currents,* or an alteration in the mean dampness of the air, would alter all the conditions of life on our continents, and clothe them with abundant snows, such as we find in the southern hemisphere.

§ 7. *On some Observations desirable to be made.*

I will briefly refer to a few of the many observations desirable to be made with reference to the glaciers of Norway, which may be recommended to future travellers:—

1. To ascertain whether unquestionable and well defined snow fields occur south of lat. 60°; the level of the

* A very eminent foreign geologist once suggested to me the possibility that the rise of temperature since the glacial period might be due to the direction of the Gulf Stream upon the coasts of Europe by the elevation of the American continent.

snow line, and the period of the year at which it retreats highest.

2. To examine the glaciers on the west slope of the Justedal mountains, and at the head of Sogndal and Veitestrandswand, and to trace to their origin the remarkable granite boulders which seem to be derived from thence (page 155).

3. To select amongst the glaciers of the Justedal range one or more suitable for careful observations of progression, both during the height of summer, and from year to year. The Lodals glacier is probably one of the best.

4. To ascertain carefully the snow line of the Folgefond, and in Nord-fiord (between Justedal and the sea).

5. To visit and describe the glaciers of the Ymesfield, &c.

6. To explore the country to the W. and N.W. of Sneehättan on the Dovre-field; to observe its geology, and ascertain the level and extent of its snow fields.

7. Generally, in the preceding excursions, to notice the occurrence of grooved and polished rocks, and the direction, by compass, of the striæ, especially on level places, not in the declivities of valleys. The attempt to trace generally the boulders to their origin could only be attempted by persons familiarly conversant with the intricate and obscure geology of Norway. But moraines should be watched for and sketched. That of Vasbotten, near Stavanger, mentioned by Esmark, would be worthy of a visit.

8. In Nordland, and the higher north, the traveller may explore the Börgefield, between the Namsen and Vefsen, rivers frequented for their fishing by numerous tourists.

9. The glaciers and snow fields of Fondal (lat. 66°-67°) would unquestionably repay a week or a fortnight's re-

search. From the steam-boat station of Rödö, the Mels-fiord, Holands-fiord, and Gloms-fiord, might be easily visited, of which the two first at least contain glaciers at a very low level. The mountains of Fondal are in a great measure detached from the interior chain, and it is probable that the explorer might return from Gilleskaal, beyond Cape Kunnen, by the landward side, to the head of the Ranen-fiord (lat. 66° 10′), and rejoin the steamer.

10. The promontory of Lyngen, with its numerous glaciers, might be made the object of an excursion from Tromsö, with the aid of the steamer.

11. A detailed examination of the Bergs-fiord, Jökuls-fiord, and Qvenanger range, has been already recommended (page 84).

12. Every opportunity should be taken to ascertain the direction of the abrading and smoothing agency, which has left such extraordinary traces along the coast, between the Throndhjem-fiord and the Lofoddens; and in general it should be sought to observe how far the striæ correspond or not in direction with the general declivity of the ground, or whether they are in any case *extensively* parallel with the coast.

13. The limits of vegetation of the birch and the snow line should be observed wherever practicable; but with regard to the latter, the great difficulty of ascertaining the *extreme* limit of recession of the snow should be borne in mind, and the time of year, the character of the season, and the exposure, should be particularly noticed.

14. The meteorology of Norway is in a state which is not creditable to the acknowledged intelligence of the people, and the eminence of its scientific men. I know of but two places, Christiania and Kaa-fiord (separated by

10° of latitude), of which the mean temperature is known with any accuracy. This is lamentable in a country whose climate is one of the most interesting in Europe. The means of remedying it seem easy. Let observations, in the first instance, be confined to the *thermometer*. It is impossible to doubt that a net-work of, say 50 stations, might be quickly established over the entire country. The intelligent officers of the Royal Marine and Trigonometrical Survey, the clergy (who have almost all had a university education), the masters of schools and academies, like my well-informed friend, Mr. Blom, at Tromsö, the active magistrates and civil officers, even the station-holders and substantial merchants on the steamboat routes, would probably, in many instances, lend a cheerful aid to so simple and interesting an inquiry; whilst the combination of the results could not be placed in better hands than those of the professors of Christiania.

§ 8. *On some Peculiarities of the Scenery of Norway. Waterfalls.*

The scenery of Norway, which is, of course, the result of its physical peculiarities, may be divided into three classes—that of its valleys, its *fields*, and its *fiords*. The first resembles, on the whole, that of the tamer parts of the Alps; often picturesque, sometimes grand, and occasionally highly pleasing, especially near the lakes. The second is in some degree peculiar to this country, and must disappoint many who are not prepared for its singularity. These *fields*, or *fjelds*, are often interminable wildernesses, undulating or varied only by craggy heights devoid of majesty, rarely

attaining the snow line, but spotted over with ungainly patches of white. Von Buch, all whose descriptions betray a very ardent determination to exalt the scenery of Norway, compares the aspect of Sneehättan to that of Mont Blanc as seen from the Breven! But it would be difficult, I should think, to find a seconder for such a judgment. The height of the summits of Norwegian mountains above the table-land which forms their base, is usually too small to give them much effect. But the scenery of the fiords and the profound valleys, which may be considered as the mere prolongation of them, is the really distinguishing feature of Norway as regards the picturesque. It is analogous, indeed, to that of the west coast of Scotland, but on a scale of much greater grandeur; and by those who have fully appreciated, with due leisure and under favourable circumstances of weather, the magnificent scenery of our Hebrides, including Orkney and Shetland, and the western firths, the praise will not seem small. The depth of the inlets, the precipitousness and continuity of the cliffs, the number and singular forms of the rocks and islands, occasion a succession of prospects the most varied and surprising. Then the frequent appearance of perpetual snow, and the occurrence of glaciers close to the sea, give a vivid contrast to the luxuriance of vegetation, and the warm tones of colour which in fine weather commonly prevail.

But of all the contrasts which Norway presents to other mountainous countries, the abundance of running water is perhaps the most striking to a stranger; its noble rivers and its impressive waterfalls are perhaps the features of the scenery most generally dwelt upon, and many tourists seem to make the latter the sole or main objects of their search. This, I think, is a mistake. A cascade is a noble

object as forming part of a landscape, but it is often situated so as to be well seen only when every other part of the landscape is excluded. If dwelt upon exclusively, it becomes a mere *lusus naturæ*, not an element of scenery; and, if made the exclusive object of a laborious journey, can scarcely fail to disappoint. I have not seen the most celebrated falls of Norway, for my other objects of inquiry did not lead me near them; but having visited those of other countries, I have come to the conclusion that, setting aside the curiosity and rarity of a lofty cascade, smaller waterfalls, unexpectedly discovered in picturesque situations, convey a truer sense of pleasure and beauty to the mind, than the thundering shoots which tumble often into nearly inaccessible gorges. In the former class, Norway abounds beyond calculation; running water of a bright and sparkling green is seen on every side, at least in the valleys; it pours over cliffs often in a single leap, but more frequently and more effectively in a series of broken falls spreading laterally as it descends, and rivetting the imagination for a long time together in the attempt to trace its subtle ramifications. The sound is rather a murmur than a roar, so divided are the streams, and so numerous the shelves of rock tipped with foam; whilst a luxuriant vegetation of birch and alder overarches the whole, instead of being repelled by the wild tempest of air which accompanies the greater cataract. At other times single threads of snow-white water stretch down a steep of 2000 feet or more, connecting the *field* above and the valley below; they look so slender that we wonder at their absolute uniformity and perfect whiteness throughout so great a space—never dissipated in air, never disappearing under *debris;* but on approaching these seeming threads we are astonished at their volume, which is

usually such as completely to stop communication from bank to bank.

The source of this astonishing profusion of waters is to be found in the peculiar disposition of the surface of the country so often referred to. The mountains are wide and flat, the valleys are deep and far apart. The surfaces of the former receive and collect the rain, which is then drained into the narrow channels of the latter; and as the valleys ramify little, but usually preserve single lines, and are wholly disconnected from the *fields* by precipitous slopes, it follows that the single rivers which water those valleys represent the drainage of vast areas, and are supplied principally by streamlets which, having run long courses over the *fields*, are at last precipitated into the ravines in the form of cascades. The system might be represented in a homely way by great blocks of houses in an old-fashioned town, the roofs of which collect and transmit the rain-water by means of communicating gutters, until, on reaching the street, the whole falls by means of open waterspouts, flooding the water-ways below.

But there is also another reason for this striking abundance of water. The fall of rain is large, if not excessive, over a great part of Norway. It is also, no doubt, greater on the *fields* than in the valleys of the interior. The height of the mountain plateaux is such as to be covered more or less with snow during two-thirds of the year or more; during this period the rivers and cascades are comparatively in many cases absolutely dry. The vast accumulations of autumn, winter, and spring are to be thawed during the almost constant warmth of the long summer days. In this season alone, the interior of Norway is usually visited, and we see the result in the amount of

drainage concentrated into that brief season. In the Alps, no doubt, a similar cause is active; but the comparative rarity of the cascades is explained by the absolute want of table-lands, and the infinitely ramified character of the valleys. In the Pyrenees, which have a still more ridge-like character than the Alps, the cascades are more numerous, but yet far more scanty.

JOURNALS OF EXCURSIONS

IN THE

HIGH ALPS OF DAUPHINÉ, BERNE, AND SAVOY.



SCENE AT LA BERARDE.

CHAPTER I.

NARRATIVE OF EXCURSIONS IN THE ALPS OF DAUPHINÉ IN 1839 AND 1841.

BOUNDARIES OF THE DISTRICT DESCRIBED—MOUNTAINS OF OISANS—THEIR GEOLOGICAL PECULIARITIES—HOT SPRINGS—ALLÉVARD—LES SEPT LAUX—ALLEMONT—BOURG D'OISANS—VALLEY OF THE ROMANCHE—VALLEY OF ST. CHRISTOPHE—VENOS—FALL OF A MOUNTAIN—VILLAGE OF ST. CHRISTOPHE—SCENE FROM LES ETAGES—MONT OURSINE—HAMLET OF LA BERARDE.

TRAVELLERS have often bent their steps to the remoter regions of the globe to the neglect of objects worthy of

attention which might be found almost within their daily range. The soil of Palestine and Egypt is more trodden, and has been more minutely described than many parts of Europe, heedlessly passed over in the anxious haste to remove ourselves as far and as fast as possible from home associations. It may be doubted, however, whether those who pass the great highways of the Alps at a gallop, or are urged with almost railway speed at once by current and by steam down the course of the Rhine and Rhone, are always directing their steps to objects more worthy of attention (for the most part, certainly, to objects more frequently described), than those which exist but a few miles to the right hand or to the left of those beaten tracts, along which tourists follow one another, like a flock of sheep, in interminable succession.

Amongst these almost unvisited, yet far from inaccessible districts, the Alpine country of Dauphiné, including part of the modern departments of the *Isère* and *Hautes Alpes*, is one of the most interesting, whether we regard its geological structure, or the almost fantastical sublimity of its remote and thinly peopled glens. No great road passes through this country. The pass of Mont Genévre, which approaches nearest to it, being very little traversed and now partly out of repair, so that the fortress of Briançon, the frontier town of France on this side, forms nearly the *terminus* of communication on the great line of fine road, which stretches along the whole course of the river Durance down to Aix and Avignon. Having been led in the course of an excursion on foot in the year 1839 amongst the Southern Alps, to visit a portion of this country, of which the interesting geology, as described by Mr. Elie de Beaumont, had formerly excited my attention,—and having

penetrated a certain way into its remoter valleys, which, from want of time, I left with regret,—I took an opportunity in the summer of 1841, of revisiting them, in company with my friend, the Rev. J. M. Heath. We proposed crossing some of those cols or elevated mountain passes which are described as being frequented only by chamois hunters, although they form often the sole communication between valleys, distant horizontally but a few English miles—even this extremely limited communication being practicable during but a very few weeks in the finest part of summer. Accounts to this effect were confirmed by what I had previously seen of the continuous and terrific precipices which bound on both sides the valleys, or rather ravines, (called by the natives *combes*), of this granitic nucleus; and with respect to the weather, Mr. Gueymard, an eminent engineer of Grenoble, has assured me that the statement I have quoted is by no means exaggerated, and that the higher mountains of Dauphiné are rarely accessible for more than the last ten days of July and the first week or two of August.

The country of which I propose to offer some description includes a mountain group of granitic formation, and no very large extent, which is separated from the main chain of Alps stretching from Mont Cenis to Monte Viso, by the great valley of the Durance, already mentioned. The form of the group is rudely circular, marked by the outburst of granitic and talcose rocks, through the prevalent strata of Lias and Chalk which characterise this part of France. It is bounded to the north by the river Isère, where it passes Grenoble, and by the course of the river Arc, which, taking its rise near the Mont Cenis, flows into the Isère above Montmeillant. These two rivers form an angle, which is

filled by a chain of mountains also granitic, and which at their culmination constitute a desolate and stupendous mass, covered with perpetual snow, and called *Les Grandes Rousses*, whose geological structure has been partly described by Mr. Dausse in the Transactions of the Geological Society of France.

On the west, our district is bounded by the river Drac, which unites with the Isère below Grenoble, and which, rising at Orsière, not far from Gap, in the department of the Hautes Alpes, nearly touches the river Durance, which again forms the south-eastern boundary of the district between Embrun and Briançon.

Within this space, only about forty-five English miles square, rises the highest summit occurring in the mountainous country between Mont Blanc and the Mediterranean. It is called Mont Pelvoux, and its height is 13,468 English feet, as determined by the French engineers, yet it does not greatly exceed in elevation other summits in its neighbourhood, which are so imperfectly known to topographers, and so variously or inaccurately named on maps (as well as by the natives), that it is difficult to ascertain their identity, on account of the unapproachable positions which many of them occupy, surrounded by precipices, and by glaciers yet more inaccessible.* To this general group may be given the name of *Montagnes de l'Oisans*, which has been applied to them by Mr. E. de Beaumont in a paper published in the 5th vol. of the *Annales des Mines*, in which he has described with much detail and spirit the

* There exists, however, a most admirable and faithful map of Dauphiné by General Bourcet, which may (or might lately) be had at Paris. It is engraved in a quaint, old-fashioned style, but extremely clear, and its fidelity makes it invaluable to the traveller.

remarkable geological features which they present. These are of two kinds, the structure of the granitic or gneiss rock itself, and the phenomena which it presents when in contact with the stratified deposits of limestone which surround it. The whole is considered by that most eminent geologist to afford an example of a *Crater of Elevation* in a formation not properly volcanic—the originally horizontal structural planes of the gneiss having been elevated on all sides towards a central point or apex, from which, consequently, they appear to dip in every direction. "It presents," he says, "something resembling the form of a half closed flower, of which the stamina are represented by unstratified masses of granite and dislocated fragments of gneiss, and of which the corolla corresponds to the strata of gneiss, which nearly throughout the circumference of the group rest upon the interior granite, and which sink beneath the secondary deposits raised up around in the form of the calyx." *

Mr. Elie de Beaumont was also one of the first to signalise,† in 1829, the existence of that remarkable inversion of geological superposition, in which granitic rocks are found overlying limestones of the age of lias—a circumstance more lately noticed in several parts of the Swiss Alps, but nowhere, if we mistake not, with more perfect evidence than in the mountains of Oisans.

The most considerable of the fissures of which we have spoken forms the channel of the river Romanche, which intersects in its tortuous course some of the highest ground of the district. Near the village of Bourg d'Oisans, the

* Faits pour servir à l'Histoire des Montagnes de l'Oisans, p. 30.

† Mémoires de la Société d'Histoire Naturelle de Paris, tome 5, cited and figured in De la Beche's sections and views, 1830.

valley divides itself into two; the stream which retains the name of the Romanche joins the other nearly at a right angle, having flowed in almost a straight course from east to west in the profound gorge called the *Combe de Malaval;* whilst the other branch, taking the name of the Veneon, runs nearly from south-east to north-west through the valley of St. Christophe, and takes its rise almost at the foot of the Mont Pelvoux, amongst the glaciers which fill the vast rocky basin in which lies the little hamlet of La Berarde, considered by Mr. E. de Beaumont as the centre of action of the elevating forces.

The occurrence of mineral and thermal waters near the outskirts, and not at all in the centre of this district, confirms remarkably the views which I have stated in a paper on the mineral waters of the Pyrenees in the "Philosophical Transactions" for 1836. The great convulsions which were productive of fissures, both in the stratified and unstratified rocks, gave vent to these subterranean streams, which issue generally from chasms exactly on the line of demarcation of the primitive and secondary formations. Mineral veins are also not unfrequent accompaniments. The waters of La Motte near La Mure, on the course of the Drac, are exactly in the situation just described, and appear in connexion with small outbreaks of granite indicated in the geological map of France. They are described as issuing from a ravine so narrow, confined, and precipitous, that the water (which is stated to have a temperature of 45° Reau.) has to be carried on the back of mules to some distance before it can be administered medicinally. Two other sources which I have myself examined occur in the valley of the Isère, exactly on the confines of the primitive and secondary rocks. That of Uriage, about six miles from

Grenoble, is sulphureous, and rises in a deep valley at the junction of granite and lias, which is, however, concealed for some way by an immense mass of detritus, through which the spring forces itself. It is conveyed in a subterraneous conduit for a space of six or seven hundred yards from its source to the bathing-house, where it issues with a temperature of 70°.5 F. The other spring is that of Allevard, several leagues to the north-east of the former, which rises in a small tributary valley of the Isère, exactly where a stream called the Breda, descending from the high ground of the chain already mentioned as connected with Les Grandes Rousses, opens into the valley. This little ravine, which is wild and picturesque, appears to have been formed by a rent, and communicates in a manner no less striking in a picturesque than in a geological point of view, between the tame scenery of the fertile lias and the savage grandeur of the snow-clad granite peaks upon which this natural gateway immediately opens. It is exactly at the entrance, then, of this ravine, and within a few hundred yards of the junction of the limestone with the primitive talc slate, that the sulphureous mineral water, which is extensively employed for medicinal purposes (although not possessing a high temperature), immediately rises. Extensive workings of carbonate of iron are carried on in the same neighbourhood. The sparry iron divides from the walls of the vein innumerable fragments of the matrix, which is a greenish talc slate.*

It was on the 21st of July 1841, that Mr. Heath and myself, profiting by the fine weather which, in the midst

* Allevard is a convenient point from which to commence our narrative, although it is not in this direction that the mountains of Oisans are most easily approached.

of a very changeable season, accompanied us in our rambles amongst these mountains, quitted Allevard by the ravine just described, and followed the torrent of the Breda up towards its source, which has been termed in the patois of the country Les Sept Laux, or the Seven Lakes. Between the villages of Pinçeau and La Ferrière, we noticed the remarkable occurrence of a polished convex surface of gray slaty rock, very similar to those occurring near the Handeck and on the Grimsel. Unfamiliar though we at that time were with these supposed traces of glacier action, we could not help being struck by the perfect rotundity presented by the exposed surfaces of the rock, exactly at such a contraction of the valley as must have exposed it to the shock of any descending mass. The polish too was extremely perfect when we removed the covering of soil; the hard and the soft parts being equally sawn across at an exact level, and smoothed with wonderful precision. It appears to me, upon recollection, as indubitably marked a specimen of this kind of action as is anywhere to be found in the Alps of Switzerland. It occurs at a very considerable height above the bed of the torrent and close to the path, but we could trace it for a considerable way above and below, although it was only in this part of the valley that it attracted our attention.

After passing an uncomfortable night at La Ferrière, we proceeded to ascend the col of the Seven Lakes. A long and steep ascent, generally, however, practicable for mules, led us to the first of the lakes in question after five hours' walk. This series of small and beautifully clear tarns lies in a prolonged ravine, which at a great height separates the chain commanding the valley of the Isère from the granitic mountains to the east. By our

barometrical observations, the elevation of the col is 7144 feet, yet these lakes are fed by springs, and are not like the usual accumulations of stagnant water derived from the melting snows. The temperature of the first lake was 46°.5, whilst that of the river Breda, half a league above La Ferrière, at a height 4000 feet less, was only 46°, arising, no doubt, from the glacier origin of the main branch of that stream, which at Prinçeau, below La Ferrière, had a temperature of 52°.5, at Allevard of 54°, and at Ponte Charra of 56°. Near the last of the chain of lakes is a small building where travellers might sleep better upon hay than in the wretched beds of La Ferrière. The situation is wild and gloomy, commanding no distant views, the chain of lakes being closed in by bare peaks of no great elevation on all sides.

After a long rest we proceeded to descend the southern side of the pass into the vale of Allemont, which terminates in that of the Romanche below Bourg d'Oisans. This descent is excessively fatiguing, rapid, and even dangerous. In order to avoid the precipices, it is necessary to skirt the mountains at half their height by an intricate sheep track, with which our guide, it appears, was imperfectly acquainted. After scrambling down a space of at least 3000 vertical feet, we reached in three hours the hamlet of Rivier d'Allemont. The gorge into which we descended was exceedingly striking and wild; cultivation dies away at the foot of the pass. On our left a difficult track called Le Maupas leads amongst lofty granite peaks into the valley of the Maurienne; to the right and before us, the fantastic range of La Montagne de Belle Donne throws its jagged peaks to the sky. This summit doubtless receives its name from the obvious resemblance of the

outline to the rude representations of the Virgin and Child by the earliest masters of the Italian or the Byzantine school.

Instead of stopping at Rivier, we resolved, in the hope of finding tolerable quarters, to push on to the village of Allemont, a distance of two hours and a half farther. As the evening advanced, we were fairly obliged to grope our way amidst intense darkness occasioned by the rich foliage which clothes with extraordinary luxuriance the lower part of this beautiful valley, whose fertility we found next morning to present as striking a contrast as can well be imagined to the rocky scenery of its immediate neighbourhood. Near Allemont, in the mountain of Challanche, mines of silver and lead have been worked since 1767, but have been more lately abandoned, and were for sale at the period of our journey. Our hopes of tolerable accommodation were again disappointed, and after a walk of more than ten hours, we were doomed to pass another sleepless night. We next morning took mules, first to convey us to Bourg d'Oisans* through a flat country and along a good highway, from whence we proposed to explore the valley of St. Christophe, which I had visited two years before.

The position of Bourg d'Oisans is sufficiently remarkable; it lies in a swampy flat of a mile or more in width, out of which rise, especially on the west side, perpendicular walls of rock of immense elevation. On the face of these precipices the famous gold mines of La Gardette have been worked from an early period. It is impossible to doubt that this part of the valley of the Romanche (in which the

* Bourg d'Oisans, a country town 18 miles from Grenoble, by which the country to be described is most easily approached.

village of Bourg d'Oisans is situated) was once an enormous cleft, of a depth which it seems now almost impossible to estimate, of which we see the original walls still standing; but the lower part has been filled up by the copious depositions of mountain torrents and the degradation of mountains themselves, which have formed the enormous platform of detritus amongst which the river finds its way, leaving unhealthy swamps at every stage of its passage. Such artificial obstructions have even occurred during historic times. In the lower part of the course of the Romanche, which bends suddenly at less than a right angle after being joined by the river of Allemont, it enters a profound defile called the *Combe de Gavet*, which I had visited on a former occasion, and in which a great lake was formed by the fall of a neighbouring mountain in the 11th century, which, after existing two hundred years, burst its barrier, and carried desolation into the valley of the Drac, and even to the town of Grenoble. These ravines, with perpendicular walls and zigzag courses, recall in a striking manner the scenery of Norway, especially of the Sognefiord, described in a previous part of this volume. Perhaps no other part of Europe presents so close a parallel; and, as the neighbouring gneiss formation is extremely similar, it is not too much to infer that causes not very different have operated in the two cases to produce effects so grand in themselves, and indicating such astonishing energy in their production.

The cliffs immediately behind Bourg d'Oisans are generally of limestone, and rise perpendicularly to a height probably much exceeding a thousand feet. From the base issue numerous fine springs, which appear to vary greatly in their discharge at different times, for some, which issued

nearly at the same season in 1839 in so great volume as to be impassable on foot, were now perfectly dry.* I observed, too, the great changes which the course of the torrent had made in its passage amongst the debris in which it has formed a thousand channels, and it had completely carried away the slight track which formerly led to the valley of St. Christophe. The height of Bourg d'Oisans is above 2400 feet. A few miles higher up the valley we left behind us the narrow gorge through which the torrent of the Romanche passes to unite its waters with those of the Veneon.† Following the course of the Veneon on its left bank, we soon quitted the level plain, and began to rise alongside of the torrent which chafes itself amongst numberless scattered blocks to the little hamlet of Pont Ecofier, where a magnificent scene presented itself. Behind us we could still see the whole extent of the valley of Oisans confined by its mural precipices, terminated by the distant peaks of the Belle Donne, and seeming like a vast crevasse, of which the eye could not fathom the bottom. In front, two confined and savage valleys opened right and left—that on right, of no great extent, was soon closed to the eye by impassable walls of rock; the other, from which the main mass of water descends, rushing at our feet beneath a frail bridge, presented a grand scene of rough mountains on either hand. In the extreme distance a glacier summit‡ raised itself in glorious perspective precisely

* One of these springs, a little below Bourg d'Oisans, had a temperature of 48°.5 on the 11th of July 1839, the height being about 2400 feet.

† Up that gorge a splendid new road has been carried, which, long ere this time probably, connects Grenoble with Briançon.

‡ This summit appears to be "la pointe haute du grand glacier" in Bourcet's map.

in the prolongation of the valley, richly coloured by the full beams of the setting sun; whilst in the middle distance there appeared a speck of exquisite verdure, placed as if by enchantment in the midst of a wilderness, marking the position of the little village of Venos, where live in independence, and even in wealth, the most considerable proprietors of this secluded and almost unknown valley.

The fertility of the neighbourhood of Venos, which produces so striking an effect, admits of a very simple explanation; for here the granite suddenly ceases, and a tongue of limestone is intruded into its interior, connected with the great deposit near Mondelant in the valley of the Romanche. The gentler forms of these strata are well marked, and a pass of easy access, and cultivated almost to the summit, forms the only practicable communication between these two valleys, and is composed entirely of lias. On the opposite side of the Veneon the limestone strata are prolonged still farther into the heart of the granite, and the Col de la Muselle which they form, is one of the least difficult in the interior of the group, connecting the valley of St. Christophe with the Val Joufrei. The structure of the limestone is extremely remarkable, being completely metamorphosed by the neighbourhood of the granite, so as to present the appearance of a very beautiful black roofing slate, of which it possesses all the most valuable characters. This is a striking example of the production of cleavage planes by metamorphic action.

The village of Venos is situated on an elevated slope, clothed with rich walnut woods on the right bank of the stream. It is commanded by the church, a building of Romanesque architecture, from which a good view of the valley is obtained. The green pastures which lead to the

Col de la Muselle are exactly opposite, and the contact of the granite with the lias at a great height may be distinctly perceived. The torrent which flows through it descends into the valley of the Veneon by a striking cascade, presenting a great volume of water at the season of the melting of the glaciers. It may be remarked of almost all the tributary valleys of this neighbourhood, that they do not join the principal valley at a common level, but are considerably higher, so that a waterfall, often of great beauty, almost invariably accompanies the meeting of the streams, thus presenting a fresh analogy with the configuration of Norway. The lateral valleys therefore cannot be properly considered as fissures, since their section is rounded, and a steep water-course has been cut since their formation, by the action of water in the lapse of ages. Venos is not only the prettiest village in the district of Oisans, but it also boasts a very good country inn, which we may be excused for mentioning amongst the peculiarities of the place.

In ascending the valley of St. Christophe, the gorge soon becomes narrower, the rounded forms characterizing the intruded lias are quickly left, and, the torrent having been passed on a substantial bridge, a very short distance brings us to a scene of sublime desolation. A mountain on the right hand has, at some remote time, crumbled into fragments, and literally filled the valley from side to side with a colossal heap of ruins. Through and amongst these winds a narrow path practicable for mules, whilst the river dashes from rock to rock with excessive commotion, sometimes passing under the fragments which it was unable to displace. One huge slab of granite, wide enough for three carriages to pass abreast, forms a natural and ponderous bridge, harmonizing with the desolation of the scene. The

effect of this natural barrier has evidently been, as in the Combe de Gavet, to form a temporary lake, which has since been silted up, leaving a level plain which extends for a mile or two. On the right stands the romantic village of Enchatra, a hamlet consisting of a few houses perched on a projecting rock in a tributary valley above one of the beautiful cascades already mentioned.

Not much farther on, the road leaves the stream and leads up the face of a rough hill to the village of St. Christophe, which gives its name to the valley. On this ascent several fine springs issue from the gneiss (which is here in vertical strata directed *due* north and south), at a height of about 250 feet below the village, or 4550 feet above the sea, the temperature of these, July 10th, 1839, was 44°.0, and July 24th, 1841, 43°.8. Just before reaching St. Christophe, a bridge crosses a very wild and narrow cleft, through which foams a wild glacier stream called Torrent du Diable. We addressed ourselves to the *Curé* for information as to guides who could conduct us across some of the passes at the head of the valley. He received us with great cordiality, and gave us references to two, both chamois hunters, living at the village of La Berarde, the last hamlet of the district, and to which distance his wild parish extended. We could, however, obtain but slender information as to the practicability of any of the passes connecting La Berarde with the adjacent valleys. Encouraged, however, by what we heard, we proceeded to ascend the course of the stream. Only two other villages exist higher up. The first, Les Etages, commands one of the finest Alpine views which the admirers of Swiss scenery can desire, terminated by the Montagne d'Our-

sine, which stands immediately above the hamlet of La Berarde. It presents a series of rocky pinnacles in manifold rows, between which the snow can scarcely adhere; and so utterly inaccessible does that chain appear, that any passage in this quarter to the Val Louise seems almost hopeless; in fact it is stated never to have been accomplished, except by a deserter, who having escaped many years ago from the fortress of Briançon, sought shelter in the unapproached fastnesses of the Montagne d'Oursine. Its form, as seen from Les Etages, especially by the morning light (imperfectly represented in Plate IX.), is comparable to the Aiguilles of Mont Blanc, and the valley which stretches beyond it to the foot of Mont Pelvoux may almost rival the scenery of the Allée Blanche.

La Berarde, which is placed in the midst of this savage landscape, consists of but very few and poor houses, with a small chapel distinguished from the rest by a belfry. Cultivation ceases just at the village; a few stunted pines are found still higher up, but there is no wood worth mentioning in the valley above Venos. Timber for building is all brought from Bourg d'Oisans. This excessive sterility peculiarly characterises the valleys of Dauphiné. The village of La Berarde is at a height of only 5500 feet, that of St. Christophe is 4800, and of Venos 3230, but the character of the scenery is like that of Switzerland at a greater elevation. The unbroken rocky surfaces deceive the eye to such an extent that it is difficult to realize the enormous scale of these mountains. "We seek in vain," says Mr. E. de Beaumont, "those landscapes, at once grand and graceful, which are so attractive at Grindelwald and Chamouni; the bottom of the valleys is too elevated for luxuriant vegetation. The scanty pasturage soon gives



James D. Forbes del. C. Hasholm.

Lay & Son Lithrs to The Queen.

VALLEY OF LA BERARDE — DAUPHINÉ.

place to snow or bare rock, and some poplars and straggling ash trees are alone found in the valley of La Berarde; the snows and glaciers are their only decoration, and it is even difficult to attain positions at a sufficient distance to enjoy a good view of them. Lower, no doubt, than Mont Blanc and the Jungfrau, the mountains of Oisans appear less elevated than they are, on account of the absolute height of the valleys and of their confined position, so that the summits can be but rarely seen. To ascertain their height, we must attempt to mount them, and even then the eye has some difficulty to submit to the testimony of the limbs."

Scanty as the pasturages appear, they are in great request amongst the shepherds of Provence, who annually drive thousands of sheep from the plains of La Crau and the delta of the Rhone—a long journey of several weeks—to spend a month or two at the base of Mont Pelvoux. In 1839, I saw a herd of young mules gamboling at the foot even of the glaciers. The inhabitants of La Berarde received me on both my visits with surprise, but with kindness and hospitality. Their dwellings are very low, mean, and dirty. The sight of a stranger is a rare event. In 1839 on the 10th of July, I was the first visitor of the season. On that occasion, hastening late one evening, on foot and quite alone, in search of the village of St. Christophe, where I was to sleep, I met a man of whom I asked the way. He looked at me rather suspiciously, and then with much simplicity expressed a hope that I had not been guilty of any criminal action which had caused me to take refuge in these valleys. Like most unsophisticated mountaineers, the feeling of the picturesque is unknown. A country is a "mauvais pays" in proportion as it is ele-

vated, and the curious traveller runs some risk of being taken for a treasure hunter if he carry a hammer, and in any other case, a refugee from justice. But notwithstanding this isolation, I was struck with a certain courtesy of manners and especially a purity of dialect, which seemed surprising. But I afterwards learned that there is scarcely a man in the whole valley who has not been more or less a traveller; and, indeed, that during the seven or eight months of every year, which may truly be said to constitute their winter, the whole male inhabitants, almost to a man, quit their homes, and range over every part of France as hawkers or col-porteurs—their usual occupation being vending live plants and flowers. They return in the late spring with commodities necessary for their consumption, and which their valley is incapable of producing; and in this way, as I have already said, a great deal of real comfort and independence is to be found among the inhabitants of Venos and St. Christophe, with a hardihood of character, which reminds one more of the aristocratic peasantry of the Swiss republics than that of France generally.

We found Joseph Rodier, the guide to whom we had been recommended, busily engaged in securing his hay crop, which he and his son were carrying in heavy bundles on their backs from the field to the hay-loft. Finding that no one in the village had ever crossed to the Val Louise, and that the practicability of such a feat was altogether doubtful, we enquired whether, by leaving Mont Pelvoux on the left, we could pass by the extreme head of the valley to the Val Godemar. Rodier had twice performed this, and engaged to conduct us across the glacier which lay in the way next morning. It turned out, however, that the route which we wished to take, and ultimately took,

across the Col de Sais, had, so far as we could learn, been traversed by no one in the valley. We spent the afternoon in inspecting the neighbourhood, and received the most hospitable kindness from the family of Richard, to whom we had been recommended by the curé of St. Christophe. To sleep in the house was (fortunately) impossible; a truss of clean straw was prepared in the hay-loft, and some of its numerous apertures were closed for the occasion. We had brought coverlets as well as provisions from Venos. All our property was most carefully and considerately put under lock and key; and, though our instruments and equipments furnished food for the curiosity of all the children, and many of the grown inhabitants of the village, we experienced not the slightest rudeness or attempt at imposition. We hung our barometer at the door of the very same cottage (Richard's), at which I had done the same two years before; and though the observations, owing to the distance of the station (Marseilles), with which they are compared, do not very closely agree (and even the morning and evening observation give a considerable difference due to temperature), the height of this interesting station may be approximately given at 5550 feet above the Mediterranean.



MONT PELVOUX FROM THE VAL LOUISE.

CHAPTER II.

CROSS THE COL DE SAIS, EXCEEDING 10,000 FEET—GLACIER DE LA CONDAMINA—DESCENT TO LA CHAPELLE—PASSAGE OF THE COL DE CELAR—GLACIER AND DANGEROUS PRECIPICES—ENTRAIGUES—VILLE DE VAL LOUISE—MONT PELVOUX—MONESTIER—COL DE LAUTARET—SUPERPOSITION OF GNEISS TO LIAS—LA GRAVE—THE SCENERY—COMBE DE MALAVAL - PASSAGE OF THE COL DE INFERNETS—REMARKS ON THE GEOLOGY OF THE MONTAGNES DE L'OISANS.

THE weather next morning was very favourable, and, impatient to avail ourselves of it, we were up before four o'clock; but our haste was in vain, for the guide did not make his

appearance, nor was it, until past six, that by our united exertions we could accomplish the fulfilment of his many preparations, which his wife (who appeared to have given but a reluctant consent to the journey) by no means accelerated. No one had for years attempted the passage, nor does any stranger appear to have crossed from the valley of St. Christophe to the Val Godemar. Our guide from Venos (who was to return with the mule which had brought our provisions and knapsack), a kind-hearted man, who now visited for the first time this part of the valley, declared it was "le bout du monde," and entreated us not to think of going farther. But seeing that we were not to be moved in our resolution, Rodier at last completed his breakfast of boiled chamois—filled his spirit-flask, took leave of his wife and the other villagers who collected to see us off, and we addressed ourselves to our journey.

For two hours above La Berarde the ascent is not rapid. Opposite the valley of La Pirade, the most considerable ravine which descends from the Montagne d'Oursine on the left, the valley divides into two branches, both extremely grand. By either we understood that the Val Godemar might be reached; but we were not then aware that our guide had passed only by the one to the right. We preferred the other, which kept close by the foot of Mont Pelvoux, whence we were to cross by the Glacier de la Condamina and the Col de Sais. Rodier, who was an excellent mountaineer and a trusty guide, though he had never passed this way, had satisfied himself on his previous journey, as he afterwards told us, that if the top of the Col de Sais could be gained on the side of La Berarde, the descent would be practicable on the other. Leaving then the valley of Clos Chatel (in Bourcet's map) to the right, we

ascended the Vallée de Compte Faviel, and reached the foot of the glacier in two hours from La Berarde. We passed a stone cabin, in which slept a Provençal shepherd. The glacier at first was not steep; our course lay nearly due south, and when we had passed opposite to the highest summit of Mont Pelvoux, we turned more to the right, where the glacier divides into two branches. The fallen rocks had hitherto been true granites, consistently with the views of De Beaumont, but now they passed into epidote rocks, and others composed of felspar and hornblende, perhaps analogous to the variolites of the Drac. These gave place, as we ascended a very steep bank of debris, to more slaty forms; and the Col de Sais is composed of an intermixture of the preceding rocks with those in which talc forms a prominent ingredient, a mineral which appears to characterize a district of this group, lying in a north and south direction, passing through La Berarde, and coming out near the Col de Lautaret. I speak only in a very approximative manner; but the rocks on the north side, between the Lautaret and Monestier, have the same character.

Having reached a considerable elevation by climbing on the shingle, we dined (without, however, the advantage of water), and descended upon the higher part of the glacier by a moderately inclined snowy slope intersected by occasional crevasses. Our more direct course would have led us to cross this arm of the glacier near its base, and to have ascended the opposite side; but this Rodier justly considered imprudent on account of the recent traces of avalanches. But though we were now nearly on a level, or at least not greatly below the Col de Sais, we had still an anxious passage to make across an extensive glacier basin,

which was traversed by impassable rents in various directions, nor was it practicable to ascertain from a distance whether these could be got round or not. At length, having descended considerably, all difficulties were overcome, and a gentle snow slope led up to the summit of the pass. The barometer stood at 19 in. 4 lines French, and the thermometer at 34° of Fahrenheit. The height we computed to be 10,224 English feet.* This we gained at one o'clock. Notwithstanding the cold and an approaching snow-shower, I made a careful survey from this magnificent station of the country we had just left, and took a sketch of the outline of Mont Pelvoux and the neighbouring chain, in which the Montagne d'Oursine stands out with its double head in great prominence. The view commenced at the Aiguille du Midi de la Grave on the left, to the right of which is a practicable but rarely traversed path from La Berarde to Villard d'Arène; next the Montagne d'Oursine, with a most precipitous abutment to the south-east. This is followed by the Pointe de Verges—a peculiarly pointed summit marked by Mr. Elie de Beaumont in his ideal section as the centre towards which all the upraised gneiss strata seem to point. I cannot say that the extensive and commanding view I now enjoyed altogether confirmed this opinion. There are undoubtedly points of view presenting a section of the mountains of Oisans from E. to W. which seem to indicate something like an anticlinal axis running N. and S.; but, from the Col de Sais, the mountains within view have a singularly rough and formless appearance. There is a gap between the Pointe de Verges and the Mont Pelvoux, and through this gap it is possible that a passage

* It is called 3358 metres, or 11,017 English feet, on the authority of De Zach in Brugière's *Orographie de l'Europe.*

into the Val Louise might be attempted; beyond and through it appear (as I judge by the direction on the map) the distant peaks of the Mont des Agniaux. There rose just opposite to us, and to a height of more than 3000 feet above us, the pyramidal summit of the Mont Pelvoux itself, which predominates over the whole.

As we reached the Col de Sais, a cold sleet shower passed over us, and the sky became overcast. Fortunately it was not violent or continued, for we looked with some anxiety to the descent, which our guide had never traversed. The view to the south-west carried the eye into the Val Godemar at a profound depth (nearly 7000 feet) below us. The prospect of the descent was sufficiently fatiguing, if not dangerous, for, as we attained the summit, we looked over what appeared a precipice perhaps 3000 feet high, composed of rock intermixed with snow-beds of extreme steepness. There was, however, no alternative, and we boldly faced the abyss. Our intelligent guide, avoiding the inclines of snow,* led us down the least difficult parts of the precipice of rock with skill and address. The rock was still composed of a mixture of steatitic gneiss, with a variolite composed of felspar and augite, which occurs in large grained patches. The footing was often by no means firm, the rock decomposing into angular fragments ; but the last part we accomplished easily and agreeably by allowing ourselves to slide down a moderately steep declivity of snow until we reached the pastures, when, looking back to the precipice we had passed, it seemed very nearly inaccessible, in the ordinary sense of the word. Near the bottom we saw a chamois. Our progress was now easy and rapid.

* A narrow one, but of formidable steepness, and softened by the warmth of the day, we were, however, compelled to cross.

Each chose his own path, and we ran gaily over the very steep pastures which form the upper part of the wholly uninhabited Val de Gioubernez. At the junction of this valley with the main one of Godemar is a fine cascade, buried so deep in a ravine that it can with difficulty be seen; and a little below is the hamlet of Le Clos, where it might be possible to sleep; but we preferred walking two hours farther down the valley to the first *commune*, that of La Chapelle, where we arrived about 7 P.M.

The arrival of strangers at La Chapelle is at all times a subject of surprise, but when they came from the glacier-bound head of the valley, it was a matter of curiosity to the whole inhabitants of the village, a majority of whom appeared to be more or less under the influence of wine (being a *fête* day); and, as we were driven from door to door by the hope of finding a decent lodging, we were followed by crowds of curious speculators. The mayor of the village was seated in the crowded room of the filthy *cabaret*, which formed the only pretence of an inn. A glance at the beds satisfied us that it was impossible to sleep there, and having submitted with calmness to the drunken expostulations of the man of office on the illegality of the spiked alpine poles which we carried, we at last, after much delay, found shelter with the curé, whose timely hospitality we have good reason to remember. Clean beds and a hospitable meal were offered to us with simplicity and kindness, and we were invited to stay all next day, an offer of importance, for we had another long and difficult alpine walk before us, and desired some repose.

A short excursion into the valley of Navette gave us some farther insight into the singular character of this part of Dauphiné. When we had descended to La Chapelle, of

which the elevation is 3525 feet, we supposed that the Val Godemar was one which offered easy communication with the neighbouring valleys; but this is far from being the case. Its lateral branches, like La Navette, are sealed with glaciers, and it is an arduous day's journey to escape on either hand from the single narrow channel which the stream of the Val Godemar (called La Severaisse) flows to join the Drac. By La Navette is a pass leading to Champoleon, a point of geological interest, on account of the displaced and altered limestones, but it is so lofty as to be covered with perpetual snow. My desire to visit Champoleon did not equal that to explore more completely the environs of the Mont Pelvoux, and to intersect again the heart of the chain by passing from La Chapelle to Val Louise, whence we proposed, by the circuitous route of Fressiniére to reach Champoleon, and to return to La Chapelle by the Col de la Meande.

In the neighbourhood of La Navette, in the ravine called the Combe d'Ourcette, the same limestone occurs, which at Champoleon and other places in this neighbourhood, breaks into the granitic nucleus. This is very well marked in the geological map of France; but the authors of it do not appear to have been aware that a stripe of limestone, composed of highly inclined strata and of considerable extent, crosses the upper part of the Val Godemar in a N.N.W. and S.S.E. direction,* and communicates, in all probability, with the valley of Champoleon on the one hand, whilst it stretches away into the Val Joufrei on the other. Fragments of the epidote rocks are extremely

* This is also the direction of the gneiss strata. This band of limestone crosses the Val Godemar at the village of Rion du Sap. The limestone communicates apparently with that of La Navette.

abundant near La Navette, and I observed an amydaloid, which I afterwards noticed at Monestier, near Briançon, but which I have not found *in situ.*

The following day we prepared to start from La Chapelle to cross into the Val Louise by the southern branch of the chain of Mont Pelvoux. Our intention was nearly frustrated by the suspicious activity of the police. A rumour of the arrival of strangers armed with iron-shod poles across the glaciers had reached the town of St. Firmin at the foot of the valley; and the gens-d'armes arrived just in time to intercept our departure, which had been retarded by the morning mists. Seizing upon an irregularity in my friend's passport, they had almost detained us, but the letters with which I had been kindly furnished by Mr. Arago procured our liberation, and we started to ascend the Col de Celar at a later hour than we should willingly have done had we been aware of the difficulties which awaited us.

We had to retrace our former steps to the highest hamlet of the Val Godemar, named Le Clos, consisting of but a few scattered houses, after which cultivation ceases, and we laboriously ascended the steep but rich pastures which intervene between the valley and the glacier, which as usual descends from the col. After two and a half hours of ascent, and four and a half hours from La Chapelle, the glacier was gained. The latter part of the way was extremely rough over the loose moraine. At this great elevation I gathered a specimen of metamorphic limestone, of which doubtless some imbedded fragments are to be found in this central and very elevated range. The limestone had a bluish colour, and was accompanied by a portion of red schist almost converted into porcelain jasper. It is probable that their position and relations would be very

interesting if discovered; for here we are upon the verge of the true granitic nucleus, and we quit for a time the strata of gneiss. The scenery during the ascent is very grand. The stupendous mountain, marked Garroux on Bourcet's map, with a *talus* of bare rock as steep as a house roof, broken here and there into pinnacles, and powdered with the fresh snow of the past night, rose majestically on our right. At length we entered upon the snow, and after crossing a considerable tract, came to the first rocky step or stage, over whose centre a glacier pours its torpid mass, taking its origin in the mountain basin above, at the foot of the col. This barrier of rock was gained easily, but the access to the col promised greater impediments. The unusual quantity of snow of last winter had prevented all access to the second tier of rocks, except by crossing its steep inclined surface, which was of great extent, and being at this advanced time of day completely softened, presented a kind of walking which, though not difficult in itself, required the utmost precaution, since an ill placed step would infallibly have launched the traveller on the soft snowy slide—a circumstance which had occurred but a little before to one of the party, when it was only a matter of amusement, since no greater danger than a fracture of the barometer was to be apprehended, whilst at present, unless by great address in the use of the pole, the victim of a false step must have slid down a snowy bank of some hundred feet, and landed amongst glacier precipices at the bottom. For a whole hour we had to pick our steps along this disagreeable slope, and gently mounting, at last reached the foot of the final precipice which conducted us to the col. It was soon climbed; when a scene not less striking in its way than that from the Col de Sais presented itself.

The col was a mere ridge of angularly shattered granite, rising on both sides into fantastic forms of singular wildness of outline. Before and behind us were glacier basins, the one of which poured its tribute into the Vallon des Bancs (a tributary of the Val Louise), the other into the Val Godemar. We stood suspended above both, with the intervention of a rocky precipice, so that our position resembled a gigantic wall of masonry, battered by time and the elements into irregular embrasures, and to which the snow could scarcely cling. The barometer stood at 19 French inches 6 lines $\frac{3}{10}$; the temperature of the air was about 36°. Consequently, the height was nearly as great as that of the Col de Sais, and proved to be 10,073 English feet.

We had ascended above 6500 feet, and had nearly an equal descent before us, which evidently was not unattended with difficulty, for beyond the glacier basin immediately before us the eye in vain sought for a slope to guide it into the seemingly unfathomable depth of the valley beneath; in truth, the glacier is guarded by precipices on every side. A great rent separated the snow from the rock: this was our first difficulty, but soon overcome. We had little time to waste, for we had spent eight hours in climbing the col. The glacier basin was crossed without any of the difficulties we had experienced in ascending; but we soon reached the rocky chasm which separated us from the habitable world beneath. Our guide, who had already passed this way several times, led on with confidence and skill; but it required all our assurance to follow him down the almost perpendicular cliff, exposed and convex, without any of those narrow crevices into which a man can, with a little

practice, squeeze his body, and let himself gently down. This was a work of clinging from step to step; and though our guide manifested much patience for our slow movements, he had none of the adroit usefulness of the Swiss guides, whose familiar acquaintance with travellers enables them to assist in a thousand ways, and many of whom have often risked their own lives to save that of their employers. The chamois hunter of Dauphiné feels (not unnaturally) no such bond between him and the traveller whom he conducts, and will often scarcely take the trouble of making a circuit however trifling, to avoid a pass which would make the hair of a common tourist to stand on end. Here, however, there really was no escape. Precipices surrounded us on all hands, unless where they were masked by vertical walls of ice, or snow beds of impracticable inclination. To turn back was out of the question. Evening approached, and the col was not yet far behind us. Who would stand upon trifles at such a moment?

In the course of this descent, I was not inattentive to the nature of the rocks by which we were compelled continually to cling, and was particularly struck by the occurrence of thin green veins or dykes cutting the granite-dykes, which at the time I took for serpentine, but a more careful inspection shows to be green felspar. These are doubtless of the same nature with the dykes of felspar described by Mr. Elie de Beaumont on the Col de la Pisse, between St. Christophe and the Val Joufrei. One of the dykes on the Col de Celar exhibited a shift or dislocation. Having reached in safety the foot of a precipice several hundred feet high, we found ourselves on the level of the glacier, and thought that our descent would now be accomplished on its surface; but from this the guide entirely dissuaded

us. Fresh traces of avalanches were everywhere strewed on the steep surface over which we must have passed. Before us rose a buttress of rock, by the foot of which the glacier swept, and which, therefore, it was impossible to turn. There was no alternative but to climb over it. A new cliff was to be scaled, then a longer precipice was to be descended by ledges of scarce a handsbreadth; but this being accomplished, we found ourselves on a moderately inclined slope of snow, which, owing to the very unusual extent which it had this season attained, stretched into the valley for a distance of nearly two miles, along which we slid and ran at ease; and, as we approached the first habitations of the Val Louise—the wretched hovels of Entraigues—the evening had already fallen, and we looked back almost with awe to the rugged heights from which we had just descended, flanked by glaciers and rocks which appeared equally inaccessible.

Entraigues (as its name imports) is placed at the union of two streams, of which that on the right descends from the Vallou de Beauvoisin, which offers a circuitous but less difficult communication with the Val Godemar which we had just quitted. To remain at Entraigues was out of the question, so we pushed on in the dark for fully two hours farther, to gain the *chéf lieu* of the valley, the poor village which goes by the imposing name of the *Ville* de Val Louise. We soon found ourselves amongst wood; and, even in the twilight, we could see that the stern features of the granitic mountains had yielded to the gentler character of the limestone hills, which commence an hour above *La Ville.* These hills are studded with villages and church spires, their tops clothed by the warm green pine woods, their

flanks covered with fresh pasturage, and the well watered valleys rearing stately walnut and other trees, present a scene more verdant and engaging than our eyes had rested upon since quitting Allemont; for even Venos, beautiful as it is, and owing its beauty to the same cause — the limestone formation — is but a gem set in a massive framework of granite peaks on every hand.

Little of this, however, we saw till next morning. All was dark long before we arrived at the Ville de Val Louise; and we wandered disconsolately about its deserted streets, composed of great barns more than of houses, with those vast projecting roofs and verandahs which characterise this part of the French Alps, under which in unfavourable seasons the poor inhabitants strive to preserve from total destruction the crops which have not had time to ripen on the stalk ere the autumnal frosts have seized upon them. At length we got a direction to the house of the Curé, the traveller's best resort in Dauphiné, where we were hospitably received, and lodged better than we had any reason to expect.

The position of this village is remarkable. It lies near the union of the valley of Entraigues, which we had descended with the principal branch of the Val Louise itself, called l'Alefred, which stretches up quite to the foot of the monarch of the group, the Grand Pelvoux itself, which, though at no great distance, cannot be seen from the "ville" on account of the hill which rises immediately behind. It is from this side that the ascent of the Mont Pelvoux has been attempted; and it appears that the French engineers succeeded in attaining a summit but little inferior to the very highest point which has acquired the

peculiar name of *Pointe des Arcines* or *des Ecrins.** It is, as we have said, estimated by the French engineers to be 4105 metres, or 13,468 English feet above the sea, by Carlini and Plana 4100 metres, and by Von Welden and the Austrian engineers† 12,612 French or 13,442 English feet. It is, therefore, the highest mountain between Mont Blanc and the Mediterranean, Mont Iseran being 4045 metres (Corabœuf), and Monte Viso being only 3836 metres—a height surpassed by several of the mountains of Dauphiné.

The Val Louise is, as I have observed, very fertile in its lower part; and, when we descend a few miles below the town, the Mont Pelvoux is seen to rise with almost architectural solidity and boldness, the prominences of the granitic tables giving an effect, now of buttresses and now of pinnacles, which is exceedingly grand.‡ Below the pretty village of Vigneaux, the valley contracts by the approach of the limestone rocks, and then opens rather abruptly on the valley of the Durance. We shall not detail the features of the country farther in this direction, because we soon quit the prescribed limit of the district we have to consider, but shall conclude with a short description of the north-western boundary of these mountains.

The proper group of Oisans is bounded in this direction by the valley of Monestier, by which the stream of La Guisanne flows to join the Durance a little way below Briançon. It takes its rise at the Col de Lautaret, the mere watershed of the two extremities of one and the same valley, which terminates in a north-easterly direction in the deep gorge of the Combe de Malaval formerly

* De Beaumont, Memoire, p. 19. † Der Monte Rosa, p. 30.

‡ See the vignette at the head of this chapter.

alluded to. This great valley, in its whole extent, occupies nearly the boundary of the granite and lias, the limestone of the upper part of the Val Louise being, according to M. Elie de Beaumont, "nummulite" limestone or chalk. At Monestier, about six miles above the valley of the Durance, the glaciers appear on the left descending from the group of the Montagne des Agniaux, which, according to the same author, are composed of gneiss strata so regularly disposed as to be easily mistaken for limestone at a distance, dipping to the N.E. The strata of this part of the range appear to be very close in their nature, and resemble those of the Col de Sais. A gentle ascent leads to the summit of the Col de Lautaret, which is covered with verdure to the very top; and even the neighbouring mountains are clothed to a great height with pasturages of the utmost luxuriance, filled with a greater and more gorgeous variety of flowers than I recollect to have seen in any other part of the Alps. The height of the col is 6740 feet, and from it a view of wonderful grandeur is obtained down the gorge of Malaval, and especially towards the Pic du Midi de La Grave, rising to a height of above 13,000 feet, fancifully compared by M. Elie de Beaumont to a gigantic nut-cracker menacing heaven with its open jaws. Immediately to the south of the Col de Lautaret is a very remarkable mountain which presents a section of granite and limestone which has not been, I believe, described, and which does not yield in interest, or in evidence of inverted superposition, to that at Villard d'Areine, so ably described in the memoir just cited.

Immediately above the village called Pied de Lautaret two streams unite, whose courses are separated by a hill not named in Bourcet's map, but descending from the Point de Combeiron, whose sides, parallel to each ravine, form a

horizontal angle varying from 60° to 90°. When this promontory is viewed in front it is evident that the superior part is composed of granite or gneiss, and that the base of the whole hill is limestone. This I had noticed in a general way in 1839, but in 1841 I quitted the road at the Col de Lautaret, and after ascending above a thousand feet, I reached the junction of the two rocks, where the limestone dips under the gneiss at an angle of from 65° to 70°. Both rocks were very materially altered at contact, but within a few feet of each other were perfectly well characterised. A similar section was obtained at *each side of the hill;* the limestone dipping under the gneiss both ways, so as to leave not a moment's doubt that we have here a cap of primitive rock overlying the secondary rocks, just as we so often see in the case of basaltic summits resting upon stratified bases. The view of the junction from Villard d'Areine (a village below the *Pied de Lautaret*) leaves nothing to be desired, after the nature of the rocks has been ascertained by actual inspection.

A great road, leading from Grenoble to Briançon, was being conducted, at the time of our visit, across the Col de Lautaret. Already great difficulties had been overcome. When completed, it will vie in the wildness of the scenery through which it leads with almost any of the Alpine passes. The descent from Villard d'Areine to La Grave is steep, and the nature of the rock (a crumbling black calcareous slate) opposes peculiar difficulties to the engineer. A striking cascade is passed, the whole grandeur of the glacier of La Grave is spread out before the traveller as the path winds through the narrow street of La Grave, and then plunges steeply into the ravine of Malaval. This remarkable chasm, the result of some awful convulsion, runs nearly east and

west, and is bounded on either hand by a wall of rock so steep as effectually to conceal the vast ice-fields by which (on the south side) it is surmounted. The fallen masses of rock which strew the valley equal in magnitude those between Venos and St. Christophe, whilst the almost monotonous straightness and uniformity in breadth of the defile, and the towering walls which shelter it even from the mid-day sun, give the ravine a character of sombre wildness, which the almost total absence not only of wood, but of verdure for many miles, serves to increase. The great public work, the formation of the new road, has taken something from the solitude of the scene, and yet the scale is so great that the eye may almost overlook the tunnels and embankments which have cost years of labour.

At La Grave we enter again upon the granitic formation, which here, near its junction with the sedimentary rocks, is, as usual, metalliferous. The galleries from which the copper ore is extracted open in the face of naked cliffs in spots apparently inaccessible to all but birds; yet up these cliffs are carried wooden tubes through which the broken ore is allowed to slide down to be smelted at the works beneath. It is in these mines that the crystals, for which Dauphiné is so celebrated amongst mineralogists, are commonly found.

This defile, with slight variation of direction, extends as far as the valley of the Veneon, which, as already mentioned, it joins at a short distance from Bourg d'Oisans, which is about 18 English miles from La Grave, or 36 from Monestier.

The valley of the Romanche just described is separated from the valley of the Arc and the district of the Maurienne by the lofty range of mountains of which the cul-

minating mass is that of the Grandes Rousses, already adverted to. This savage mountain rises to a height of 11,900 feet above the sea. It is consequently covered by perpetual snow, and the distance of every part of it from inhabited valleys must have rendered its geological description by M. Dausse a task of no small labour. The most prolonged chain connected with it stretches in an easterly direction towards Briançon, and presents numerous passes, all of considerable elevation, by some of which the valley of the Arc may be reached from those of Dauphiné in the course of a long day's walk. The excursion from La Grave to St. Jean Maurienne presents some subjects for geological remark with which I shall conclude these observations.

The ascent of the hill, immediately behind the village of La Grave to the northward, soon commands fine views of the ravine of Malaval and the mountains which rise to the south. The church, a picturesque structure of the Romanesque style, stands on a green eminence, right in front of the great glacier which streams from the Pic du Midi; and immediately to the left of it is admirably seen the section of granite and lias, which are there in contact for above half a mile, and after rain the colour of the rocks distinguishes them perfectly at any distance. The first heights gained, we overlook a small tributary ravine which pours its torrent over a precipice of granite into the valley below to swell the volume of the Romanche. A beautiful cascade, just above the hamlet of Les Freaux, is the result, and this little stream intersects the junction of the granite and limestone, the whole cliffs of the Combe de Malaval being, however, composed of the former, and the limestone over-

lying it, and dipping to the W.N.W.* The mountains to the northward, notwithstanding their elevation and bareness, being composed of limestone, afford good pasture; and in the small tributary ravine just mentioned, not far above the cascade of Les Freaux, lies the secluded village of Chazelets, a frontier station of the French custom-house officers, whose duty requires them to watch this dreary frontier of Savoy. My letters procured me a good reception from them, and likewise a guide for the pass to St. Jean de Maurienne—that which we selected as the most direct is called the Col des Infernets. As we mounted, our attention was continually attracted by the increasing magnificence of the southern range opposite to us. The higher we ascended the more lofty did it appear—the more we receded the more did it enlarge. So completely is it true that the grandeur of these mountains is lost sight of, in consequence of the profundity of the ravines. Like a great city seen from a distance, its spires and turrets come first into view, when we emerge from the confinement of its streets. What seemed but a naked wall of black rock from the depths of the vale of the Romanche, now stood forth as but the colossal base of trackless snow-fields of many leagues in extent. Above and through these, rise fantastic summits,

* Elie de Beaumont, p. 44. A little below Les Freaux, in the valley of the Romanche, and on the right bank of the river, I found, where the rubbish had been cleared away in the recent excavations, a mass of limestone. I am unable to say whether it was there *in situ*, or was only a portion of an enormous mass which had fallen from the rocks above. As the cliff *there* contains, so far as I know, no limestone, the latter supposition is in some degree improbable, though it might have descended from between Les Freaux and La Grave; but were the limestone really beneath the cliffs of gneiss, the fact would be a very interesting one, as representing a wedge or stratum of gneiss contained between two of lias.

which perpetual winter clothes almost every week of the year with a slight covering of snow, again to be tossed towards heaven by the stormy blasts which echo from rock to rock, whose sounds, though mingled with the thunder of the avalanche, are all unheard by ear of man or beast.

The height of the Col des Infernets is not known, and our barometer was now broken; but, by the time required for the ascent, I estimated it at fully 5000 feet above the village of La Grave, which I had previously determined to be 4971 feet above the sea, giving, therefore, a height of 10,000 feet. It was the *third* pass of this elevation (besides several lower ones) which we crossed in little more than a week. On the second of August it was covered with fresh fallen snow to a great depth, though in the latitude of only 45°; but it offered no farther difficulty than steep and dirty paths. So piercing, however, was the cold even at this season, that, though we walked as fast as we could, we had not descended very far into Savoy before my companion had nearly fainted from the effects of the alternations of temperature to which we had been exposed. The descent to St. Jean from so great an elevation was of course extremely long, and being in great part over arid limestone rocks, which for many miles afforded not a drop of good water, and cut the feet by their angular fragments, we were sufficiently fatigued ere we reached the fertile valley of the Arc, smiling with verdure, the hills clothed with rich woods, and the valleys with fruit trees, vineyards, and maize—in strange contrast with the arctic scenes we had left but a few hours before. But how various are the causes of human happiness or misery! At La Grave not a stick can be had for firewood. Cow dung is the chief combustible in a climate which may truly be said to consist of nine months

of winter and three of bad weather. Poverty, and cold, and filth offend the senses; and yet who would exchange the robust and healthy constitution of the mountaineer of Dauphiné for poverty amidst luxuriance, filth amidst natural beauty, with the superadded curse of Cretinism and Goitre in the sunny valleys of the Maurienne?

The view from the Col des Infernets presents a noble profile of the Dauphiné Alps, viewed from the N.W. Though the question of the manner and form of elevation of the gneissic formation, with its superincumbent limestone, is rather to be determined, in my opinion, by a careful comparison of the dip and direction of strata at various points, than by the outline of the mountains seen at a distance, yet the latter is also well worthy of notice. The conclusion to which I on the whole incline is this, that the elevation has not been so much circular and directed towards the valley of La Berarde as a centre, but rather towards an axis of elevation running N.N.W. and S.S.E., and passing through that locality. This supposition will correspond to the really well-marked features of the profile when viewed in either continuation of that line, as, for instance, from mountains beyond Bourg d'Oisans, or from the main chain of Alps in the direction of Barcelonette; whereas in the contrary direction, as from the Col de Sais and the Col des Infernets, the mountain profile being parallel to the axis of elevation, no trace of grouping round a centre is perceptible. But the best confirmation of this view will be found in the following observations of the direction and dip of the strata (most of which have been collected from incidental notices in M. Elie de Beaumont's excellent memoir), which, though occurring in all parts of the group, indicate a very general tendency to parallelism in the direction which I have indi-

cated, excepting the neighbourhood of a single locality, La Grave.

Locality.	Formation.	Direction of Strata.	Dip.
St. Christophe . . .	Gneiss.	N.N.W.	Vertical.
Mont d'Agniaux above Col d'Arcine . .	Gneiss.	N.W.	30° to N.E.
Pointe de Combeiron .	Gneiss.	N.W.	30° to N.E.
Montagne d'Oursine .	Granite.	N.W.?	To N.E.
Pic du Midi de la Grave	Granite.	N.W.?	To N.E.
Grand Pelvoux . . .	Gneiss.	N.W.	To S.W.
Entraigues, Val Louise	Gneiss, sandst. and limest. of age of chalk.	N.W.	45° or 50° to S.W.
Les Freaux, La Grave	Gneiss.	N. 20° E.	70° to W.N.W.
Villard d'Arène .	Contact Gneiss and Lias.	N.N.E.	65° to E.S.E.
Do.	Lias.	N. 60° E.	50° or 55° to S.E.
Val Godemar . . .	Gneiss.	N.N.W.	Nearly vertical.

CHAPTER III.

EXCURSION ON THE GLACIERS OF THE BERNESE ALPS, PRECEDING THE ASCENT OF THE JUNGFRAU.

ENGAGEMENT WITH M. AGASSIZ—RESIDENCE ON THE GLACIER OF THE LOWER AAR—TOPOGRAPHY OF THE BERNESE OBERLAND AND THE GLACIERS ORIGINATING NEAR THE FINSTERAARHORN—TWO PANORAMAS—EXCURSION FROM THE GRIMSEL TO GLACIER OF ALETSCH IN VALAIS—DEPARTURE—THE GLACIER AND COL OF THE OBERAAR—DESCENT ON THE GLACIER OF VIESCH—CAVERNS IN THE NÉVÉ—ENORMOUS BLOCK OF STONE ON THE MORAINE—ARRIVAL AT THE CHALETS OF MARJELEN—PREPARATION FOR THE ASCENT OF THE JUNGFRAU.

THE summer of 1841 I spent in a series of journeys requiring almost constant exertion. The month of June and part of July was devoted to explore part of the volcanic countries of central France, in company with my lamented friend Mr. John Mackintosh.* The remainder of the month was devoted, in company with Mr. Heath, to the excursions in Dauphiné, which have been partly recorded in the preceding pages; and from thence we proceeded by the shortest practicable route to reach the Grimsel Hospice in the canton of Berne, where I was under an engagement to meet M. Agassiz of Neufchatel on a certain day. This cost us seven days of continuous exertion,

* An account of the results is contained in a paper in the 20th volume of the Edinburgh Transactions.

during which we twice crossed the main chain of Alps, and also several other passes of considerable elevation.

Arrived at the Grimsel, and having met M. Agassiz, we proceeded, by his kind invitation, to pass some time on the lower glacier of the Aar. During several weeks, when not compelled by stress of weather to seek a more hospitable shelter, we remained in a sort of bivouac under a huge stone on the moraine of that noble glacier, and acquired an intimate acquaintance with the varying features of that astonishing ice-world which few persons have an opportunity of visiting, except for some hours at a time, generally urged by haste or overcome by fatigue. I here willingly record that I shall never forget the charm of those savage scenes; the varying effects of sunshine, cloud, and storm upon the sky, the mountains, and the glacier; the rosy tints of sunset, the cold hues of moonlight, on a scene which included no trace of animation, and of which our party were the sole spectators. M. Agassiz had lately published his interesting work on the glaciers, in which he embodied the bold reasonings of Venetz and De Charpentier with the results of his own observation. Guided by this, and the ready illustrations by means of examples on the spot, which M. Agassiz was as willing to afford as I was desirous to learn from, I soon found that a multitude of interesting facts had hitherto been overlooked by me, although I was already tolerably familiar with alpine scenes, and with glaciers in particular. Animated and always friendly discussions were the result; and, without admitting in every case the deductions of my zealous and energetic instructor, I readily allowed their ingenuity. Thus the later weeks of August passed; and the separation of the party was approaching. Mr. Heath and myself intended

to close the campaign in the environs of Monte Rosa, and to cross the pass of Mont Cervin. In order to arrive there, we wished to avoid the long return down the valley of the Rhone from the Grimsel to Briegg, and I enquired as to the possibility of finishing our survey of the snowy territory commanded by the giant peak of the Finsteraarhorn, by traversing the glaciers near its southern base, leaving the Rhone valley considerably farther to the south. I learned that this was practicable, and M. Agassiz kindly promised us the use of his best guide. Eventually, however, he and his other friends determined to be of the party, and farther proposed, if circumstances turned out favourably, to attempt the ascent of the Jungfrau, which it was well known could only be attained from the southern side.

The arrangements, so far as this part of the excursion was concerned, were undertaken and carried out entirely by M. Agassiz, and with him rests the credit of our success. I was not at all aware of the nature of the ground, the obstacles to be overcome, or the chances of doing so. Perhaps I did not attach so much consequence to the result as did some of my companions, with whom it had been a subject of meditation and discussion in a previous year, and I desired to be considered as a supernumerary. One reason was, that I had, a week previously, severely sprained my back and leg by half falling into a concealed crevasse on the glacier of Gauli, an accident which made me lame for some days, and from which I had not by any means recovered when this expedition was decided on, of which the *preliminary* journey only was to be a formidable day's work of twelve hours, nearly all over snow and ice. I will only here add that the ascent of the Jungfrau proved a sovereign remedy for the sprain.

It may be convenient for the better understanding of the journal which follows, to sketch briefly the disposition of the mountains and glaciers through which our journey lay.

The principal group of the Bernese mountains, which runs parallel to the great chain of Alps in nearly a N.E. and S.W. direction, has the Finsteraarhorn for its culminating point. It is principally bounded on the north by the valleys of Lauterbrunnen and Grindelwald, and on the south by the valley of the Rhone. The northern side is by much the steepest, has the smallest valleys, and the least considerable glaciers, but the aspect of the mountains is on that account more imposing. On the south, and also on the east, on the other hand, lateral valleys of great extent are found, the slope is most gradual, and the glaciers are the largest in Europe.

On the north side, the Jungfrau, with its companions called Mönch and Eigher are the most conspicuous, because they overhang the valleys, and the elegance of the form of the former has given it a deserved reputation second to none other in Switzerland. It is from this side absolutely inaccessible. The Finsteraarhorn is situated nearly due east from the Jungfrau, and belongs to the same range, but it is near the centre of the mountain mass, and from it the glaciers may be said to radiate. The chief ones we shall now recount—(1.) The only glacier of considerable size on northern declivity is the Lower Grindelwald Glacier. Its reservoir, or snow basin, is extensive, and takes its rise close under the northern foot of the Finsteraarhorn. (2.) The principal branch of the Unteraar (Lower Aar) Glacier also rises immediately from the foot of the highest precipices of the

same mountain. It is separated from the glacier last mentioned by the col of the Strahleck, a passage of considerable interest and some danger, from Grindelwald to the Grimsel. This glacier has two branches or affluents. That farthest from the Finsteraarhorn rises between the Schreckhorn and Wetterhorn. The Unteraar Glacier has a nearly due E. course, and the hospice of the Grimsel lies in its prolongation. It is remarkable for its vast extent and level surface, and here the annual progress of a glacier was first measured by the energetic Hugi. (3.) The Oberaar (Upper Aar) Glacier is parallel to the former. It does not spring so immediately from under the Finsteraarhorn, but from the south-eastern spurs of it at no great distance. This glacier is separated from the last by an excessively rugged and probably impassable ridge. (4.) The glacier of Viesch, which runs almost perpendicularly to the last, and is separated from it at one place by a col or pass of no great difficulty though very elevated, takes its rise at the southern foot of the Finsteraarhorn, which, in the only two ascents which have been made of it, is approached on this side. The snow basin or *névé* is wide and magnificent, and the glacier is proportionably long, and descends to a comparatively low level, so as to reach within no great distance of the valley of the Rhone above Briegg, where the village of Viesch (from which no doubt it takes its name) is situated. (5.) The glacier of Aletsch, the largest in Switzerland or Europe, runs nearly parallel to that of Viesch, but a little farther west, being separated from it by a range of rugged hills. A passage from one to the other may, however, be effected in the higher part near the great chain, and also not far above the lower termination of the glacier of Viesch, where are situated the châlets of Mörill or Mär-



w, Wetterhorn. *s*, Schreckhorn. *f*, Finsteraarhorn. *e*, Eigher. *m*, Mönch. *j*, Jungfrau.

THE BERNESE ALPS FROM THE NORTH.



Jäger Glacier. Aletsch Gl. Ægisch-horn. Viesch Glacier. Col of Grimsel. Rhone Gl.

a, Aletsch-horn (concealing the Jungfrau). *m*, Mönch. *t*, Trugberg. *v*, Viescherhörner. *f*, Finsteraarhorn. *o*, Oberaarhorn. *sc*, Schaubhorn. *n*, Nägeli's Grätli. *t g*, Trift Glacier. *g*, Gallenstock.

THE BERNESE ALPS FROM THE SOUTH.

jelen, referred to in the following pages. The glacier of Aletsch has three main feeders—one which comes from near the ridge to the west of the Finsteraarhorn; the central one from the south-east foot of the Jungfrau and the back of the Mönch; a third from the direction of Lötsch to the westward. The western boundary of the Aletsch glacier is the magnificent mountain of the Aletsch-horn, which has numerous though smaller glaciers of its own, and with which our survey may for the present terminate.

These details will, I hope, be made more clear by the two annexed panoramic views taken from my own sketches, one of which represents the Bernese Alps from the north, or as seen from the town of Berne, the other from the south, as seen from the commanding summit of the Wasenhorn, near the pass of the Simplon. The former presents in grand succession the noble forms of the chain. It commences with the Wetterhorn on the left; next the Schreckhorn, boldly stands out—the upper glacier of Grindelwald being intermediate, though unseen. Next comes the slender and distant but imposing pyramid of the Finsteraarhorn, between which and the spectator (also too low to be seen) is the lower glacier of Grindelwald. Then follow in a culminating series the Eigher, the Mönch, and the Jungfrau, the last being seen in its most familiar aspect. It is followed by the Gletscherhorn and Ebenefluh.

The second view is a portion only of an extensive panorama, taken under very favourable circumstances in 1844, from the Wasenhorn, at a height of at least 9000 feet, which may be attained without much difficulty from the Simplon hospice, and which commands unquestionably one of the grandest views in the Alps, extending from the Dent du Midi to the mountains of the Valtelline. The portion connected

with the Bernese Alps is here engraved, and, though on a small scale, gives a sufficient idea of the scenes described in the following pages.* The Grimsel hospice, from which our tour commences, is situated in the valley immediately beyond the col of the same name, which, owing to the great elevation of the spectator, appears in a depressed position towards the right of the figure, but a little to the left of the glacier of the Rhone. The hospice from which we started is in fact just under the rocky ridge marked Nägelis Grätli. The Oberaar glacier, first traversed in the following tour, lies behind the horizon of the view to the right of the Oberaarhorn. The *col* or *joch* of the Oberaar, by which we descended on the glacier of Viesch, lies between the Oberaarhorn and the mountain between it and the spectator, which is the Kästenhorn. The descent of the glacier of Viesch is well seen, and the passage in a depression of the mountains between Viesch and Aletsch is immediately behind the summit of the Æggischhorn, which is comparatively in the foreground of the panorama. Concealed, therefore, by the Æggischhorn are the châlets of Märjelen, where we passed the night, and also the lake of Aletsch; but the extent of the glacier of Aletsch in the direction in which we traversed it, to its head beneath the Mönch, is well seen, only the Jungfrau is unfortunately concealed by the majestic form of the Aletschhorn, which rises above the west bank of the glacier. This summit is believed to equal, if not exceed in height, the Jungfrau itself, and is perhaps not inaccessible, but it has not, so far as I am aware, been measured. It is clothed with numerous short glaciers, and in a valley to the westward lies the con-

* I regret to state, that the wood-engraver has failed in giving the desired effect to this view.

siderable Ober Aletsch or Jäger glacier, which dies away before attaining the main stream of ice. The great glacier of Aletsch terminates in the profound ravine close to the left-hand corner of the drawing.

With the aid of this description, and a tolerable map of Switzerland, it will be easily understood that the expedition which I originally contemplated was confined to passing from the Grimsel hospice to Briegg in the Valais, by passing over the Oberaar, Viesch, and Aletsch glaciers in succession. The additional excursion to the Jungfrau was to be accomplished by passing from Viesch to Aletsch, either by the upper or lower pass which I have mentioned, tracing the central stream of the Aletsch glacier to its origin at the base of the Jungfrau, and scaling that mountain as might be found most practicable, then returning to the lower part of Aletsch.

I shall now give the narrative nearly as recorded in my notes at the time.

August 27th, 1841.—We started from the Grimsel, with fine weather, at 5 A.M., a formidable company of six travellers and six guides, who carried provisions; two or three small knapsacks of clothes; two or three very small casks of wine; one of brandy; a hatchet and cord for the glaciers. Jacob Leuthold, our confidential guide, led the way, and another, by name Johann Währen, who had been under medical treatment for a diseased knee, knowing that the Jungfrau was in prospect, had stolen on before, to join us about a mile from the hospice, lest he should have been prevented from accompanying us. These two excellent guides were deserved favourites. Währen, a powerful, large, good-humoured, intrepid man. Leuthold, a spare, sinewy, also very strong man, with a small twinkling grey eye, intelligent

expression, and a mild thoughtful face, which was very engaging, and at the same time showed a degree of resolulution which inspires confidence. As we walked down the slope from the hospice, the less bright stars were vanishing before the dawn, and we thought that the situation had never before appeared half so romantic. Scarce a word passed in our numerous company for two hours, except a faint exclamation on meeting Währen. Each was occupied with his own thoughts of how the expedition might end —which of the objects proposed he should attain—and probably all felt that they were engaging in an enterprize of some danger as well as labour, voluntarily, and on their individual responsibility—a thought which affects for a moment the most volatile. We thus traversed in silence the well-known path leading to the Unteraar glacier, but soon left it to the right, when we took the opposite bank of the river, and proceeded by the faint track through loose masses of stones, which we had one day followed before, leading up the right bank of the Aar towards the Oberaar glacier. Long before the sun had risen upon our valley, Leuthold and Währen lingered behind the other guides (who preceded us), to point out to M. Agassiz a distant peak just touched with sunlight. It was the Jungfrau! * Little was said, some perhaps doubted the assertion, but all probably welcomed it as a good omen touching the projected end of our excursion. The Schreckhorn, Schnee-

* The Jungfrau first has caught the rosy hue,
The Blumlis Alp and Glärnish glitter now,
And starting into life and light, we view
Lake, wood, and river from the mountain's brow.
Promethean-like the vital spark seems given,
Even at the instant, to all under heaven.
Poetische Reise (by a Lady), *p.* 57.

bighorn, and other mountains rising above the Unteraar glacier, had a grand appearance as we ascended the rugged and now pathless slope, which leads to the upper glacier of the Aar. In two hours, that is, at 7 A.M., we were already at the wretched shepherds' huts, which lie below the foot of the glacier, at a height already of 7000 French feet, (according to Hugi), above the sea. Instruments, I should have said, we had none, excepting only hammers, and thermometers, a hair hygrometer, a chronometer, polariscope, and compass. Three barometers had been broken during the summer's campaign, and one put out of order; there was none remaining to accompany us.

The Oberaar glacier lies in a wide, rather open valley; it has a regular, well defined form, with *longitudinal* crevasses near its lower extremity, and generally a well-marked vertical striated structure, parallel to its length, as in the Unteraar, although this has no medial moraine. The end front of the glacier exhibits the usual false appearance of horizontal stratification, curved upwards at the sides, as in the Rhone glacier.

The lateral moraine is well developed; the glacier is increasing, and the blocks it disengages push and furrow up the soil in wrinkles in a singular manner. We followed its left bank for about half-an-hour, then made a halt, when we observed a shepherd descending a tributary glacier on the other side at this early hour. We now got upon the ice, which presents this year a very even surface; the transverse section of the glacier below is convex—of the upper part, where it passes into *Firn*,* as usual, concave.

* *Firn*, German for *névé*, the part of a glacier from which the snow does not altogether melt. It, in fact becomes incorporated with the ice during the summer months, whilst part of it thaws.

We entered the firn, or granular snow, the higher parts of which were horizontally stratified. Walking became less secure; crevasses were to be avoided. We followed Jacob Leuthold in a line. A chamois was seen on our right. These animals are now scarcest, I was informed, in the higher Alps of the Oberland, and most frequent near Interlaken, &c. where they are protected, for the chase is illegal. Jacob has killed seventy-two, chiefly in spring and autumn.

By and bye the ascent became steeper, and the snow more yielding as we approached the col, precisely at the head of the glacier, between the Oberaarhorn and Kästenhorn. On the border of the *firn* we stopped for the important operation of putting on gaiters before entering on the snow. This our guides always did with great solemnity. The view looking back from this point was striking; the rounding and polishing of the rocks on the left side of the glacier, and to a great height, was very evident. The weather now looked no longer favourable; clouds crowned the Oberaarhorn, and even descended near the col; we pushed on, and soon reached some dangerous crevasses, which it required considerable precaution to pass. The great quantity of snow facilitated this, and at half-past ten we arrived safely at the col which divides the glacier of Oberaar from that of Viesch. The height of the col of the Oberaar is, according to Hugi, by different measures, from 10,000 to 10,400 French feet, say 11,000 English. It is a depression in the principal chain of the Bernese Alps at this point, being connected on the left with the mass belonging to the Finsteraarhorn, and on the left with the less important range which extends to the Sidelhorn and the col of the Grimsel. The rocks on the right-hand side were

schistose, intermediate between gneiss and mica slate, containing a good deal of limestone in a friable form, perhaps like that which Saussure described as calc tuff on the Mont Cervin. Some enormous crevasses prevented our descent by the right hand, on the glacier of Viesch; by the left we clambered down, partly on loose rocks, partly by the snow, and soon reached the comparatively level surface of the Viescher firn. Keller's map of these glaciers is bad; Wörl's and Hugi's detailed one are perhaps worse; and the Munich map of 1830 worst of all. It is hardly possible to recognise the position of even the chief points

When we descended from the col of the Oberaar, we had before us, and rather to the right, a col which would have conducted us to the glacier of Aletsch, where it divides in three, below the foot of the Jungfrau. The question was, whether we were to cross this col, or go down the glacier of Viesch. As we walked across the even flat, my left foot sunk in a crevasse, as my other one had done in the glacier of Gauli a short time before, an accident by which I was rather seriously lamed. It sufficed to show on what a treacherous surface we were walking, as we soon after learned more fully. Red snow was here very abundant; its colour comes out by trampling; our course was marked as by footsteps of blood. Soon after, Jacob (who had now carried for a long way the heaviest package of all the six guides) suddenly stopped, deposed his burden, sat down, and said we should dine. The suddenness of the procedure, and the arbitrariness of the command, rather amused us. But we were in no humour to dispute it, and accommodated ourselves as well as we could. A table was made of one of the porters' frames stuck in the snow, and to work we went,

with cold meat, bread and wine. After dinner, the sky was anxiously consulted. No one, perhaps, except Jacob Leuthold, understood very well what were the alternatives to be pursued in good or bad weather. He decided that the col which separated us from the Aletsch glacier should not be crossed, but that the glacier of Viesch should be descended to the Möriller See, a lake of Aletsch, where we should sleep in the châlets. Notwithstanding some grumbling from the other guides, and pointing to a clearing sky, this was put in practice.

I was glad that it was so determined. Viesch is a magnificent specimen of a glacier. The crevasses in the *firn* became wider as the slope was greater, and we saw some yawning chasms with greenish-white walls (the colour of the firn), forty, sixty, or eighty feet wide. But the grandest of all were some just under our feet. A casual opening in the snow but a few inches wide, disclosed to us several times some of the most exquisite sights in nature. The crevasses of the firn or névé are not like those of the glacier—mere wedge-like splits with icy walls—but roomy expanded chambers of irregular forms, partly snow, and partly ice; partly roofed over with tufted bridges of snow; partly open to the air, with vast dislocated masses tossing about. Stalactites of ice, possibly forty or fifty feet long,* hanging from the walls and sides exactly like those in the finest calcareous grotto, but infinitely superior in so far as the light which shews them is not the smoky glare of a few tallow candles, but a mellow radiance streaming from the sides of the caverns themselves, and which, by the faintness or intensity of its delicate hue, assists the eye in seizing the relations of many parts.

* So in my notes.

I do not recollect to have imagined anything of the kind so exquisitely beautiful as one in particular of these chasms, over which by chance we found ourselves walking, when a gap not a foot wide in its snowy roof admitted us to the somewhat awful acquaintance of the concealed abysses over which we trod.*

The horizontal stratification of the *firn* was here still distinct. Soon after, it became confused in the general rupture of the mass by the declivity over which it was forced to incline. The ice now became too crevassed to be passed in the centre, and an extensive tributary glacier (according to some, the main feeder of the Viescher-Gletscher) falling in from the right, we were unable to follow the side, and were obliged to pass over the latter, which was fearfully crevassed, and appeared all but impracticable. Nevertheless the skill of our guides accomplished this with very few bad steps; and we resumed the right moraine of the united glacier. After a pause we proceeded, not without difficulty, being forced in one place to leave the glacier entirely, and to climb the rocks and re-descend a considerable precipice again to its level. The moraine continued very uneven, and, now upon it, now on the bank, and now on the solid ice, we had a rough walk until we came to some small châlets, not a great way above the lower termination of the glacier of Viesch. Less than an hour above these châlets, we observed very admirable polished surfaces in contact with ice, whose very recent character, and the height to which they were rubbed, left hardly a doubt as to their origin. Near this we observed

* "Ringsum in dämmerenden Abgründen die Welt in grauser Gestaltenfülle sich vergletschert."—*Hugi.*

an enormous transported block on the ice, probably 100 feet long, and 40 or 50 high. It had been detached from the rocks of the higher glacier, and in the course of a few years more will be deposited on the terminal moraine. The glacier has also medial moraines, which may be traced amongst all the fissures and *aiguilles* into which it is broken. From the châlets above mentioned (marked *auf Tiler* on Wörl's map, more correctly *auf dem Titer*), we had a steep hill to ascend on the right (which, at the end of such a day's journey, was fatiguing) to reach the châlets of Märjelen. They are situated at a height, it is stated, of not less than 7600 English feet, near the Möriller or Aletscher See, on the glacier of Aletsch, which lies at so great a height here above that of Viesch, that this long and steep ascent brings us only to its level. The lake has been artificially drained in this direction to avoid the floods occasioned by an accumulation of water behind the ice of the Aletsch glacier. This condition of things is interesting, because a small increase of ice would give a second outlet to the glacier of Aletsch through that of Viesch, and the polished rocks between the Möriller See and the Viesch glacier are similar to those on the col of the Grimsel.

We arrived, some of us at least heartily tired, at half-past five at the châlets, one of which afforded much more tolerable accommodation than could have been looked for. We found plenty of milk and butter, good fire, with sufficient hay (rather damp indeed) to lie on, made more agreeable by great civility and a cordial welcome from the owners. The weather seemed more promising. If fine, to-morrow was to be devoted to the Jungfrau, and a man was despatched down to the village of Viesch for a ladder to cross the cre-

vasses. · I lay down, but could not sleep. Past eleven, the man returned from a fruitless errand, and another messenger was sent off to obtain the indispensable article at all hazards. I got up, and went out; the evening was splendid, with a bright moon. I afterwards fell asleep, and slept soundly till five, when the man returned with the ladder.

CHAPTER IV.

THE ASCENT OF THE JUNGFRAU.

HISTORY OF ATTEMPTS TO ASCEND THE JUNGFRAU—DEPARTURE FROM THE CHALETS OF MÄRJELEN—LAKE AND GLACIER OF ALETSCH—PROSPECT OF THE RANGE OF THE JUNGFRAU—THE FIRN OR NÉVÉ—THE ASCENT COMMENCES—PASSAGE OF THE GREAT CREVASSE—COL OF THE ROTH-THAL REACHED—FINAL ASCENT OF 800 FEET ON A SLOPE OF ICE—THE SUMMIT DESCRIBED—THE VIEW, AND STUPENDOUS CLOUD—RETURN TO THE CHALETS BY MOONLIGHT—THE LOWER PORTION OF THE GLACIER OF ALETSCH DESCRIBED—ITS TERMINATION IN THE RAVINE OF NATERS—ARRIVAL AT BRIEGG.

THE ascent of the Jungfrau was claimed to have been first made in 1811 by the Brothers Meyer of Aarau, who published an account of it. Their flag was not, however, seen from the valleys, and probably the inhabitants of Grindelwald were not prepared to watch for it, the ascent being made from the southern side, in which direction the Jungfrau is not visible from any inhabited spot whatever. This, the only independent evidence of their success, being wanting, doubt was thrown upon the reality of the expedition, and another of the same family, the Meyers, repeated it next year, when he asserts having again gained the summit from the eastern side. The flag, I suppose, remained still unseen, for, unreasonable as it may appear, a general scepticism continued to prevail as to their having really attained the peak of the Jungfrau. At this distance of time it is impossible to unravel these doubts, which are

not perhaps deserving of much weight,* unless in so far as they are confirmed by the unquestionable ambiguity of the narratives themselves, which is indeed such as to be scarcely accountable, except on the supposition that they had been written some time after the events—although the details of such an expedition can hardly be erased from any memory by the lapse even of years. The description by the Meyers of the very peculiar form of the summit is, however, sufficiently precise to make it very probable that it was written from observation. At the same time, it appears to me (as to others) little short of impossible, that the Jungfrau can be gained on the side of the Mönch, as described in the second of these journeys.

A long interval succeeded the journey of the Meyers; but in 1828 Baumann and some other peasants of Grindelwald unquestionably attained the summit, and by the same route as we afterwards took. The enterprising Swiss naturalist and traveller Hugi, soon after made some attempts, but from the side of Lauterbrunnen, which presents probably insuperable obstacles. He was afterwards foiled by bad weather on the opposite side, when our present guide Jacob Leuthold accompanied him. This was in 1832, the date, I believe, of the last attempt of the kind. I now resume my narrative, commenced in the last chapter.

* I observe, however, that it is mentioned by M. G. Studer, in the account of his subsequent ascent, that a respectable person assured him that he had seen the Meyer's flag from Unterseen. The Valaisan guides, on the other hand, maintained that *they alone*, and not the Meyers, reached the top. As an instance of the disposition to suggest and propagate doubts on such matters, I may mention that two years after our successful ascent, being at the inn on the Faulhorn, near Grindelwald, the ascent of the Jungfrau in 1841 having been incidentally mentioned, I heard the fact stoutly denied; and yet our flag was seen, I believe, as far as Thun.

August 28th, 1841.—The expedition for the ladder prevented our leaving the huts of Märjelen (7180 French feet, Hugi) till 6 A.M. when we set forward, the travellers first, the guides behind. Three quarters of an hour brought us to the end of the lake next the glacier. It is, I believe, the only one in the Alps in such a position, being enclosed, as I have endeavoured to explain, in an elbow of the valley in which the glacier of Aletsch rests by the ice of the glacier itself. The usual efflux of the lake is towards Viesch by the artificial canal already mentioned, but occasionally its waters drain off almost entirely beneath the ice of the glacier in the opposite direction. There are floating masses on its surface, and a precipitous wall of ice next the glacier. The artificial outlet is at the farther end next the huts. Fortunately, walking is comparatively easy on the upper part of the Aletsch glacier, for its extent is very great. We had not much trouble in traversing the crevasses, and each advanced in his own path without much communication. M. Agassiz had previously announced Leuthold's declaration, that, owing to the lateness of the hour of departure, all must be prepared to follow at a tolerably quick pace, or else give up the attempt.

At first we had the Mönch right in front, the great Eigher a little behind it, and to the right. Soon after reaching the glacier, the Jungfrau itself appeared. Plate X. is from a sketch drawn on a subsequent occasion, and gives an idea of the disposition of the mountains near the head of Aletsch.

I immediately perceived that the ascent must be up the steep snowy slope, immediately to the left of the summit, and that this would be the chief danger, if the ascent was otherwise practicable. The rocks just appeared to the left



James D. Forbes del. C. Hayter lithr. Day & Son, Lith.rs to The Queen

a. Col of the Roth-thal. b. Kranzberg. c. Pass to Lötsch. d. Pass to Viesch.

THE JUNGFRAU FROM THE GLACIER OF ALETSCH.

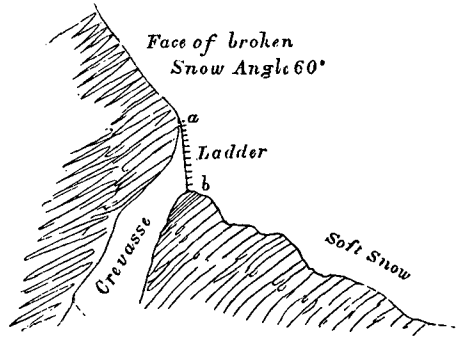
of this slope, but not so as to give much hope of a guard or safe footing; they are in fact the prominences of the tremendous precipices of the Roth-Thal, into which a false step would hurry the climber. Looking back, we had a superb view of the chain of Monte Rosa, though not of the Monte Rosa itself. The Matterhorn (Mont Cervin) rose in superior grandeur between the Weisshorn and Strahlhorn, which are generally seen from the Valais.

After nearly two hours' walk on the glacier, the crevasses became concealed with snow, and dangerous, then the whole passes into the state of *firn* and is nearly safe; whilst a great arm of the glacier (*c*) separates to the left, towards the glaciers of the Lötschthal. On the right (at *d*) we left the col leading across the range of the Viescherhörner to the top of the glacier of Viesch.

After 4½ hours' *hard* walking, we made a halt, where the snow thickened near the foot of the hill marked Trugberg in the sketch. This name (the *deceptive hill*) was given to it by some of our party in consequence of the man whom we brought with the ladder from the châlet, insisting that it was the Jungfrau—an assertion scorned by our leader, Leuthold, who knew very well what he was about, from the experience of his former reconnaisance with Hugi, when he approached the Jungfrau from a direction in which it could not be mistaken. All persons, however, who have ascended the Aletsch glacier admit that the familiar forms seen from Interlaken are no longer recognizable. The place of our halt was at the entrance of the deep bay or recess at the head of the Aletsch glacier, the Mönch before us, to the left the Jungfrau rising from the snowy plain almost precipitously. Still farther to the left, the projecting ridge of the Krantzberg, on the

right the ridge of the Trugberg. We were somewhat exhausted by the rapidity of our march from the châlets, and partook of bread and wine. Then the serious task of putting on gaiters which Jacob performed with more than common solemnity and deliberation. After half an hour we started forward up the narrowing and steepening névé, always with splendid weather. The walking became more laborious from the depth of the snow, but we followed all in one another's steps. Crevasses in the higher firn commenced, and the rope was produced. Jacob went first, having tied it round his waist. Johann Jauon held the rope fast, which was then passed round the left arm of every one behind in succession. Here the real ascent began. Melchior Banholzer, a young man we brought from the Grimsel, carried the ladder, which was 22 or 24 feet long, with great dexterity—going every where indifferently, making a path for himself, and advancing with his load whilst others rested. Several crevasses and some loose ground being passed, we were again on deep snow of considerable depth and softness. It became also very steep, and about this time we turned round the foot of the hill marked *b* in Plate X., when we found ourselves in a narrow valley terminating in precipices at the proper base of the Jungfrau. The precipices on the right were of rock, those on the left of ice and hardened snow. We pushed nearly straight forward, and attained a considerable height by climbing up the steep soft snow. At a height which I estimated at not above 12,000 English feet, I felt my breathing sensibly affected—but I was much fatigued this morning on starting; after a few steps at a time, I felt some exhaustion, which passed off after a moment's repose. Some others of the party felt the same thing about the same level.

Having passed some trifling crevasses, and rested twice, we were forced to come to a decision as to the exact course to be chosen for the ascent. The snowy precipice before us presented an enormous fissure near its base, the usual separation of the icy part of the snow on the higher mountains, and the névé or firn beneath. It was doubtful whether, on account of the limited length of the ladder, we could both cross the crevasse and ascend the steep face beyond. The section was this.



The ladder was planted at *b*, and steps made in the very steep face above, which had a good consistence, allowing the feet to be well dug in, and sustaining them. Jauon went up and held one end of the cord as a sort of rail, another holding it below, and so we proceeded one by one.* I suppose that the lower part of the ascent was at an angle of above 60°, though only for a short way. Above, the snow being

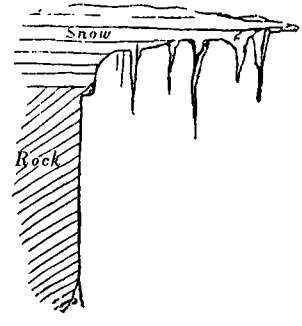
* In the narrative of the subsequent ascent of the Jungfrau by M. G. Studer, we find a striking account of a descent into this terrific crevasse of one of the guides, Banholzer by name, above referred to. M. Studer in descending had allowed his cap to drop into the abyss—nothing would hinder young Banholzer from trying to recover it. Tied by a rope, 95 feet in length, he descended amidst ice walls, and overhanging masses, and gigantic icicles everywhere menacing detachment, and when he could get no lower by aid of the rope, he detached himself, and perceiving the object of his search still below him, he quitted the rope and clambered alone out of sight and hearing of his fellows into the dim and awful gulf. He descended in all some 120 feet, then coolly returned with his prize! The crevasse, however, there seemed as unfathomable as ever.

soft, it was easy to keep our footing, and we ascended to a sort of hollow where we could rest a moment. The snow here lay at an angle of 50°.

Jacob Leuthold and some of the party had now advanced to a second crevasse more to the right, which threatened to become a gulph of separation between the fixed and the detached ice, so that the mass we had mounted since quitting the ladder might be considered as but half supported. Jacob and three others had crossed this crevasse, and I stood a little below it, when a distinct noise was heard beneath the ice. Jacob felt a *sensible subsidence*. It gave us an unpleasant sensation. We got all safely, however, across the crevasse, and mounting obliquely a soft steep snowy surface, which had been first carefully sounded with a staff, we arrived at two o'clock upon the col at the head of the Roth-Thal, a precipitous ravine on the northern face of the Jungfrau, communicating with the valley of Lauterbrunnen, and by which Hugi had vainly attempted to ascend. This col is marked *a* in the view, Plate X.; we ascended by the hollow immediately to the right of it. Clouds had now collected from the west, and attached themselves to the mountain, so that we could not see at all into the Roth-Thal; but the eastern view and the top of the mountain remained clear. Our height might be 12,800 or 12,900 English feet. There remained the final slope between *a* and the summit. Poor Währen with his bad knee was already quite exhausted, and attained this col with difficulty—but no higher.

We drank some wine and advanced to the arduous ascent, keeping to the right hand as near the precipice overhanging the Aletsch Glacier as we could do without the risk of falling through the treacherous bank of snow,

which often overhangs precipices, apparently sound and level above, but projecting like the eave of a roof without any support below, as in the figure.

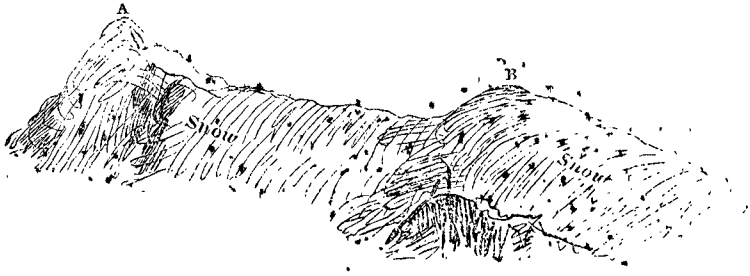


Whilst we were marching patiently at what seemed a safe distance from the edge, Jacob made us almost tremble by piercing, with a few blows of his alpenstock, the frail covering within two or three feet of us, revealing through the gap the vacuity through which we might have dropped a stone upon the glacier beneath. The snow helped us but a few paces. It was plain that the ascent was to be made over ice, and that our steps must be cut. Leuthold went first with a small axe, and with a rope round his waist, and was followed by Jauon, who improved the steps with the aid of his iron-shod staff, and held the rope attached to Jacob. Next to him the travellers, then three other guides —all of us with the rope twisted round our left arms. Since we ascended nearly straight up, as on a stair, this rope was a real security, which it could not have been to the same extent had we ascended obliquely, when the fall of one must, in all probability, have dragged the others after him. Here, if one made a false step, he would be supported by those behind, and at the same time, an alarm being given, the rope would have been tightened by all those in front. At different parts of the ascent I took the angle carefully, which in several places amounted to 43° and 45° on the real ice. The steps were more than a foot high, and we reckoned that in the course of our two hours' ascent about 700 steps were made. We estimated the height of this part of

the mountain at 800 or 900 feet. Before we had advanced far, one of our guides turned back, not liking the ascent. Next to Leuthold and Johann Jauon, Banholzer, the young man who carried the ladder, was the most successful, spirited, and attentive, and by and bye assisted Jacob in cutting the steps, having at his immediate risk jumped up the snowy ledge on the right, in order to change his place in the row. The work proceeded but slowly, when we were enveloped in clouds, which had all the time filled the Roth-Thal, in such a way that we scarcely saw into it—but at intervals we saw the top. Our position seemed rather frightful, hanging thus on a slope of unbroken slippery ice, steep as a cathedral roof, or those of the high pitched Dutch houses; with precipices at the bottom of the slope, of an unknown and dizzy depth. We were surrounded with mist, so that we occasionally only saw our immediate position, suspended thus in the midst of the frozen mountain, from which it really appeared as if a gust of wind might have detached our whole party. Fortunately it was calm, otherwise we must have suffered greatly from the cold, long before we reached the top, owing to our slow progress, and our feet being perpetually forced into the steps. I felt my toes benumbed, and had some trouble to restore animation by shaking and striking them. This slow progress, on the other hand, took away any suffering from difficult breathing. After we had gone on in the same way for nearly two hours, straight up the right hand edge of the slope, we made to the left, gained a few rocks which lay loosely there, on a less slope than the rest, and saw the top immediately before us, covered with soft snow.

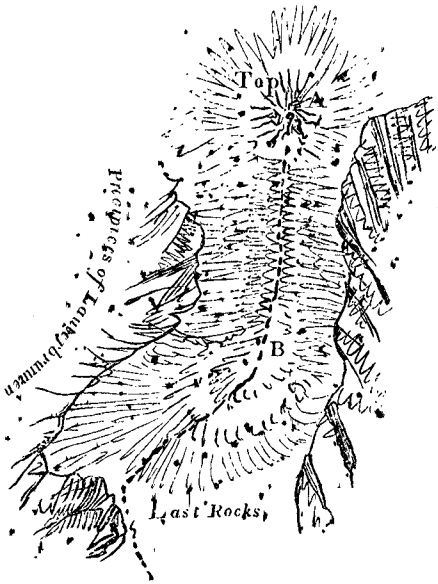
The top remained separated from us by a ridge of snow

about 30 feet long, resembling an excessively steep house roof, an expansion of which, at the farther end, formed the snowy pinnacle to which we successively arrived, but



SKETCH OF THE TOP OF THE JUNGFRAU.

could only remain one at a time.* The annexed figures (sketched soon after the ascent from recollection) will give an idea of the very peculiar form of this singular mountain top. The whole is an exceedingly narrow ridge directed nearly north and south, flanked on each side by terrific precipices. The summit B, which is snow covered, is the one first reached. The part A is but a few feet higher, in form almost like a bee-hive, of snow piled up, and so small that even when smoothed over and trodden down, scarcely



PLAN OF TOP

* The party on the top consisted of MM. Agassiz, Desor, Duchatelier, myself, and four guides.

afforded footing for more than one person at a time. The access to it is along the ridge above mentioned, apparently of heaped snow lying at the natural angle of repose, terminating in precipices on each side. The snow was fresh but binding, and the guides made a series of footsteps with the toes inwards, on one slope of the ridge, by means of which we advanced sideways, securing ourselves by the alpenstock planted on the opposite slope, until we reached the apex. In this proceeding, however, though awkward, there was no real danger, the footing being good

> Here on snows, where never human foot
> Of common mortal trod, we . . . tread;
> . . . . . .
> And this most steep fantastic pinnacle,
> The fretwork of some earthquake—where the clouds
> Pause to repose themselves in passing by. *

It was four o'clock when we reached the summit of the Jungfrau, and we staid half an hour. The view to the east was generally clear—the Finsteraar and Schreckhorn, the glacier of Aletsch, the Mönch and Eigher—and we got a glimpse of the bottom of the valley of Grindelwald. The view to the west was in one respect scarcely less remarkable, for there a magnificent cumulus-headed cloud stood in wonderful majesty, reaching apparently from the valley to at least 2000 feet above us. It was a glorious sight, a single cloud at least 10,000 feet high!

> The mists boil up amongst the glaciers; clouds
> Rise curling fast beneath me, white and sulphury,
> Like foam from the roused ocean of deep hell.

The thermometer at the top was 25°.5. When the mist approached, the icy spiculæ in it were distinctly visible.

* *Manfred*, Act II. Scene 3.

The sky to the east was clear and fine, but not of so intense a blue as we had observed it lower down, before the fog came on. On the top the polarization by Savart's polariscope seemed quite normal and distinct, the tints brighter than I have often seen them from the Aar glacier. Its intensity diminishes as the sky is of a darker hue. I took specimens of the rock, which is a sort of gneiss by no means crystalline, and we began to think of descending. I felt no discomfort or uneasiness of any kind on the top, nor did any one else. We drank some wine which we had brought with us.

The descent promised to be much more alarming than the ascent, but by the excellent management of the guides, it was little worse. We were carefully connected by the rope; the guides were distributed amongst us, and Banholzer was very useful in assisting me in placing my feet in the steps made during the ascent. We walked with our faces to the wall of ice, as in descending a ladder. During our descent I experienced a singular and painful deception. Looking accidentally into the abyss between my feet, I saw the basket and clothes we had left on the little snow plain above the ladder at the crevasse. Some of the party, who had not joined in the last ascent, had been there shortly before. I perceived something black begin to move near the spot, and descend with an accelerated pace, not unlike a man hurried along a snow incline with tremendous velocity. It was an eagle which had been examining the contents of our basket!

In one hour we reached the bottom of the slope of ice at the col of the Roth-Thal. From thence we descended the steep snow, much in the same manner, as far as the crevasse across which the ladder stood, which, when we

had passed with light and thankful hearts, we ran down the snow with little farther anxiety, for the track we had before taken guided us in safety across the crevasses. The snow had been softened since morning, so that in many places we sunk to the knee, which made the descent rather laborious. At length we reached the foot of the steep snow at 6 h. 45 m. p.m., or two and a quarter hours from the top. During the latter part of this descent, our footsteps left distinct flesh coloured marks by exposing the red snow beneath that freshly fallen.

We walked gaily along the snow in the twilight for an hour or so, till the crevasses commenced, when the moon shone out, and all clouds cleared away. We connected ourselves by a cord, to avoid all danger, and proceeded by her light at a rapid pace down the glacier, with the occasional interruption of the immersion of one or both legs of a companion, through the treacherous fresh snow which covered the crevasses or pools of ice-cold water.

We heard calls or cries of a man to the left, and thought him in difficulty, and charitably (at Jacob's suggestion) crossed half the glacier to join him. It was a messenger from the châlets, who brought warm milk and other provisions. We then pursued our way unbound down the glacier with great elasticity, by a splendid moonlight brilliancy, reflected by the crystallized surface of the ice, and still more beautiful was its effect on the ice-cliffs and islands of the Lake of Aletsch when we arrived there. We took a short rest, and then had a disagreeable stumbling walk across the blocks between the glacier and the châlets of Märjelen, where we arrived at half-past eleven, by no means overfatigued, having been seventeen and a half hours on foot. None of our party complained of thirst, though we took no

water for twelve hours at least, and part of the time the reflected heat was intense. We ate snow, however, pretty freely.

The difficulties and dangers of the ascent of the Jungfrau may be fairly judged of by the preceding, certainly not exaggerated, account. It must be remembered, however, that the forms of ice are at all times liable to alteration, and that the description of one season by no means invariably applies to another. Travellers have thus been very unwarrantably blamed for either over, or under-stating the obstacles which they may have met with in particular positions. The only ascent which, so far as I know, has since taken place, was effected by Messrs. Gottlieb Studer and Bürki in 1842, and even then, only one year after us, they found the second glacier crevasse, on the ascent to the col of the Roth-Thal, far more formidable than we had done. Another reflection suggests itself—that it was an uncalled-for exertion to cross the glaciers of Oberaar and Viesch one day, and to ascend the Jungfrau the next. The great uncertainty of the weather could alone have excused such a proceeding, especially taken in conjunction with the formidable disadvantage of making a start from the châlets so late as six a.m., and performing a forced march in consequence throughout the day. We ought unquestionably to have spent the day at Märjelen, and have started the following morning before dawn. M. Studer, indeed, passed the night on a rock half-way up the glacier, from which his party (after a miserable night) started at four a.m.; having thus, on the whole, an advantage of four and a half hours over us, yet they returned to the châlets at night very little

earlier than we had done, and remained but little longer on the top.

The day following our ascent, some of the party, including myself, proceeded from Märjelen to Briegg in the Valais by the steep and tedious, though not difficult path, by the extensive Mörill Alp, where are fed in summer large numbers of the cattle which form the wealth of the Valaisan. But I shall take the opportunity of describing the more interesting and less easy route which I traversed three years later (1844), when I re-visited Aletsch for the purpose of examining the glacier more thoroughly. Having spent two nights at Märjelen, I returned to the Aletsch See, then nearly empty, its waters having passed out a fortnight before under the ice of the glacier, and occasioned an overflow of the torrent at its extremity, and proceeded to descend the glacier, sometimes on the ice, sometimes on the left bank. The structure of the ice, so far as I could observe it during various different excursions, possesses less of the well-marked *ribboned* character which is usual in glaciers of the first order, than I have any where else observed. Its appearance is more completely crystalline than perhaps that of any of the ice in Switzerland, presenting great plates at various angles, which reflect light in the beautiful manner above mentioned, as we saw it by moonshine.*

The blue bands, such as they are, generally tend from the side obliquely towards the centre; but they are much contorted and confused. This may be explained on the principles which in my former work on the Alps I have

* The analogous structure of the Norwegian glacier of Nygaard has been described in a previous part of this volume.

applied to other glaciers, by observing the immense breadth of the glacier, and the remarkable uniformity of that breadth, the absence of great rocky promontories, and also of important tributary glaciers, all of which circumstances tend to produce (just as in the corresponding case of a river) a comparative uniformity of the motion from centre to side of the glacier, at least until within a short distance of either shore, and consequently an absence of that differential motion producing internal friction, by which the production of these blue bands has been explained. To this may be added the small inclination of the glacier of Aletsch, which in the part I principally examined does not exceed 4°, thus diminishing the effect of gravity on the plastic mass, and giving less decision to its movements. It is thus that great rivers, moving on extremely small declivities, have no absolutely regular gradation of velocity from side to centre; but the current is diverted into numerous eddies, which are not *worked out* as in a narrow stream, by the regular drag towards the faster moving mass of water in the middle.

I finally quitted the ice nearly two hours' walk below the Lake of Aletsch, and crossing over a projection of the hill, close to the châlets of Mörill, descended by a very insignificant path into the deep valley, in the bottom of which the lower extremity of the glacier buries itself, having wound round the projection just mentioned. My wish was to follow the glacier as closely as possible to the termination of its vast career, but from the point where I quitted it, the declivity increases so rapidly that the ice is impassable, and the banks become sheer precipices. The descent by which my guide (a peasant I had brought from Mörill) led me, was nearly pathless, but extremely romantic,

the green slopes being often intermixed with cliffs, and the whole partially clothed with pines. We sometimes lost our way amongst the broken ground, but at length I was gratified by a very fine view over the excessively narrow ravine into which the glacier is finally squeezed. It contracts suddenly, and the surface is dirty, crevassed, and steep. The greater part of this singular valley is inaccessible by the side of the stream, and can only be reached by long circuits over the adjoining mountains, some of which are of considerable height, for example the Bell-Alp, a summer pasturage on the west side of Aletsch. I was unable to gain a sight of the *very lowest* point of the glacier, which seems impenetrably concealed in a ravine, probably unapproachable by man. The rapidity of its fall, and its rapid attenuation to perhaps one-sixth or one-eighth of its breadth above, are very striking. It does not extend far below the point of confluence with the valley of the Ober Aletsch or Jäger glacier, the ice of which does not extend so far as the main glacier. The Ober Aletsch glacier appears accessible, and the pass from it into the valley of Lötsch is said not to be difficult. I was even assured by my guide that a man of Mörill had walked by the Bell Alp Jäger glacier, and Lötsch to Lauterbrunnen in one day!

The final descent into the bottom of the valley of Naters, traversed by the tremendous torrent of Massa, to which the drainage of Aletsch gives rise, is magnificent though laborious. The splendid range of Mischabelhörner, between Saas and Zermatt, the Matterhorn and Weisshorn, all mountains of the first class, and which in scarcely any other point of view, can be distinctly seen at once and together, filled the background of the picture. Its nearer features were not less characteristically

alpine, being a deep and richly wooded valley, in which the pines are interspersed with singular dome-shaped rocks, rising from the bottom near a spot called Auf der Platte. In the more immediate foreground, was a solitary green meadow, quite uninhabited, but containing two or three barns, reached by a lofty and picturesque wooden bridge across the Massa, which foams and roars beneath in a terrific manner. A little lower, the torrent is crossed by a water conduit, which conveys a stream from the Bell Alp all the way to the meadows of Ried, near the châlets of Mörill (which are destitute of water), the distance being several leagues. The conduit is said to be carried along the face of the precipices through the gorge of the Massa, with great boldness, at a dizzy elevation, and the peasants are accustomed to pass from one place to the other, by means of the precarious footing which it affords. The way to Briegg from the meadow just mentioned, offers no difficulty, but many picturesque sites, and everywhere may be seen the astonishing forms of the roches moutonnées, which have evidently been abraded under the anciently extended ice of Aletsch.



THE GLACIER DU TOUR FROM THE AIGUILLE DE LA GLIERE—CHAMOUNI.

CHAPTER V.

NARRATIVE OF THE PASSAGE OF THE COL DE SALENA, FROM THE VALLEY OF CHAMOUNI TO THAT OF FERRET IN 1850.

PECULIARITIES OF THE CHAIN OF MONT BLANC—GLACIER OF LE TOUR LITTLE VISITED—LEAVE THE COL DE BALME—ASCEND THE GLACIER—ITS FEATURES—ATTAIN THE RIDGE—ITS UNEXPECTED ELEVATION—EXCEEDS THE COL DU GÉANT—PROPOSED AS AN EXPERIMENTAL STATION—DESCENT ON THE GLACIER OF SALENA—FINE PROTOGINE—TOPOGRAPHY—DIFFICULT ROUTE—SUDDEN FOG—EXTRICATION—REACH ORSIÈRES IN THE VAL FERRET.

In a former work I have described the greater part of the chain or mountain group of Mont Blanc, particularly with reference to its glaciers.

It is remarkable not less on account of its isolation, both geologically and topographically, from the rest of the

Alps, than for its great elevation and inaccessibility. It is in fact merely linked on to the Alps of the Tarentaise on one hand, and those of Mont Velan on the other, by the secondary passes of the Cols de la Seigne and Ferret, which form, neither geologically nor otherwise, a prolongation of the group. The axis of the range of Mont Blanc runs nearly S.W. and N.E.; it may be said to terminate with the Col de Bonhomme on the one hand, and the mountains about Trient on the other.* In this extent of twenty-five or thirty English miles, only a single pass has ever been described, that of the Col du Géant, which is above 11,000 feet high. Besides this, are, of course, the terminal passes of the Col de Bonhomme and of Forclaz, and the Col de Balme, and the connecting attachments of the Col de la Seigne and Col Ferret, already mentioned. All of these have been described in my former work.

Having learnt some years previously to 1846 the existence of a pass quite undescribed, and known to only one or two natives of the valley of Chamouni, communicating by the glacier of Le Tour to the Swiss Val Ferret, I attempted it in that year, but was foiled by bad weather. During a very hasty journey in 1850, I was more fortunate; and as the information I then obtained throws some new light upon the topography of this part of the chain of Mont Blanc, and as the excursion itself offers some interest, I now publish an account of it from notes made at the time.

The glacier of Le Tour is the only one of those descending into the valley of Chamouni which I had not previously carefully examined. It descends in a wide, though not

* See the map of the Pennine chain of Alps in my Travels in the Alps of Savoy, and the glacier-map in Johnston's Physical Atlas. The position of the glacier of Salena is there, however, incorrect.

very imposing mass, immediately above the village of the same name, and occupies, for a long way, the right of the spectator who ascends from Chamouni towards the Col de Balme. It is lodged in a spacious valley, parallel to that of the glacier of Argentière, and to the eastward of it; it is commanded by the summit called the Aiguille du Tour to the east, and by the stately Aiguille d'Argentière to the west. Its general position amongst the mountains may be best judged of from the vignette at the head of this chapter, which was drawn from a point pretty nearly due west of the glacier, being the summit of one of the aiguilles belonging to the range of the Breven, and behind the Col de Flegère, the height of the spectator being more than 9500 feet above the sea.* The extreme left of the figure shows the slopes between the glacier of Le Tour and the Col de Balme; and the rugged mountains immediately above, form that part of the ridge which separates Savoy from Switzerland, and the basin of the Arve from that of the Trient, as well as the glacier of that name from the Glacier du Tour. As this last presents few noticeable features beyond its extent, having neither icy pinnacles, narrow gorges, nor a cavern comparable to the source of the Arveron, it is little noticed by passing tourists, and is probably quite unvisited by them.

Having determined, however, to trace the glacier to its source, and, if circumstances allowed, to descend into Switzerland by the glacier of Salena, with which I understood that it communicated, I slept at the Col de Balme on the 19th of July 1850, in company, as usual, with my tried guide, Auguste Balmat. The weather proved so stormy,

* 3140 above the Col de Flegère, by a good barometrical observation, 17th July 1850.

that I expected nothing but a repetition of the disappointment of my former attempt. But as it appeared to improve the following morning, we started, taking Michel Charlet, the tenant of the châlet on the Col de Balme, as a guide, (the route being as new to Balmat as myself) though it was already half-past eight o'clock, with the intention of at least exploring the glacier of Le Tour.

By sleeping at the Col de Balme, we have the immense advantage of starting from a level of nearly 7300 English feet above the sea. Walking first nearly on a level through the pastures towards the glacier, we soon began to ascend grassy steeps, in order to avoid the precipices which face the eastern side of the glacier of Le Tour. Having reached a certain height, we were compelled to descend a little, before gaining (at ten o'clock) the snow slopes, which still occupied the space between the moraine and hill side. These were next to be ascended, which, in consequence of the extreme softness of the snow, was fatiguing. At length, we got fairly upon the glacier, which (after attaining a certain elevation) continues to rise with much steadiness and uniformity, but which was everywhere covered with tolerably soft snow. From the considerable elevation at which we first joined the glacier, we soon reached the level of the *névé*, and, keeping too near the centre, became involved for a time amongst its enormous chasms. From these we withdrew to the left without serious difficulty, and continued to traverse the snowy basin, which here attains its widest expansion, until we passed close to the small bare rock (called by the mountaineers *rognon*) marked *c'* in the sketch, page 330, at 12 h. 50 m. The chief part of the ascent was now accomplished, and we stood face to face with the Aiguille d'Argentière, which had a splendid appearance, being cur-

tained with steep glaciers on its eastern side. We continued to advance steadily, but with labour, over the snow-fields, which still separated us from the rocky ridge of the Alps. Fresh snow lay to a considerable depth, and the hot sun rendered the effort of wading through it more fatiguing. But this was soon forgotten, in the pleasure of watching the summits, which gradually displayed themselves. Referring to the same sketch as before, *b* is the Aiguille du Tour; *c* is a snowy summit, overlooking the upper basin of the Glacier de Trient, and is steep on the east side; *d* and *e* are pyramids of rock, forming the ridge of the Alps. That to the right (*e*) is a very beautiful aiguille, and is conspicuous from a distance. It is without a name.

The ascent continued, though more gently, from the *rognon* to the Col between *d* and *e*, where we arrived at half-past one, five hours from the Col de Balme. The weather had still an unsettled appearance. Mists concealed many of the summits behind us, and also the more distant chain of the Great St. Bernard before us. The nearer peaks and glaciers were quite clear. The snow had drifted with violence into this ravine, and we took shelter from the force of the wind on a platform of rock a few feet below the level of the drifted snow. The scene towards the Val Ferret was extremely grand. Immediately beneath us, a *very* precipitous slope of frozen snow covered the rocks on which we stood, overhanging the glacier of Salena, which lay some hundred feet below. This glacier fills a fine circus of wild rocks, of which the part A B *e d* E* (see the Plan on the next page) corresponds to the main chain, separating the glaciers of Argentière, Tour, and Trient, from those of the

* The position where we stood was between the summits *d* and *e*, which are denoted by the same letters both on the plan and sketch, page 335.

Val Ferret. The chain F of wild glacier-clad rocks separates this glacier from others, also descending into Val Ferret, whilst the chain M stretches towards the glacier and



PLAN OF THE GLACIER OF SALENA.

chapel of Orny. The glacier of Salena is forced through the narrow gorge, bounded by the precipitous rocks H and L. A glance sufficed to shew the great difficulties to be experienced in descending the Swiss side.

Having reconnoitred our position, I proceeded to ob-

serve the barometer (a syphon, by Bunten) which stood at

1h 30m—505.2 millim.—Attached Ther. + 4° 0 Cent.—Detached, 30° Fah.

After a pause, I read again

504.3 millim. 0. 5 Cent. ... 29 „

I immediately perceived that we were at a height equal, if not superior, to that of the Col du Géant. Subsequent calculation indicated 4044 feet above the châlet of the Col de Balme, which, from five comparisons made with the observatory of Geneva, is 7291 English feet, or 2220 metres above the sea, a result agreeing closely with the recent measurement by M. Favre, which is 2222 metres. Adding this result to the former, we obtain 11,335 English feet for the height of the granitic axis at the lowest point between the glaciers of La Tour and Salena on the side of the Swiss Val Ferret. By a single direct barometrical comparison with Geneva,* I obtained 11,284 English feet above the sea, or 140 feet higher than the Col du Géant, and nearly 1200 feet higher than Mont Buet, which lies towards the north-west, exactly in the prolongation of the axis of the Glacier of Le Tour.

This unexpected result suggests some interesting considerations. There are few spots of the same elevation so easily accessible, and it is unquestionable that some of the numerous peaks which rise from this lofty platform could be ascended without risk, to a height of some hundred feet more. The rocks hemming in the Glacier du Tour present shelter against the severity of the terrific gales which blow at these altitudes. An observer might be stationed here for meteorological observations, with a degree of security

* The barometers were carefully prepared by Professor Plantamour, at Geneva, a few days later.

and ease which Saussure never enjoyed in his perilous encampment on the Col du Géant. Provisions could be regularly obtained from the elevated station of the Col de Balme, which is within a walk of which a mountaineer thinks little, and devoid of danger. Even the extent of surface which the mountains here present at so great a height, is itself very favourable to several kinds of observation.

I have called the fact of the great elevation of this part of the chain of Mont Blanc unexpected, both because it was entirely so to myself, and because the existing maps and models gave an entirely different idea. Even the admirable model of M. Séné, which I inspected soon afterwards at Geneva, shows a rapid depression in this part of the ridge, which indeed might have been imagined from the rapidity with which it dies out altogether in the space of a few miles in the direction of Martigny.

The temperature of the air, as we have seen, was three degrees (Fahrenheit) below freezing. As we turned round and, facing the north wind, clambered from under the sheltering snow drift, we first perceived its biting coldness, and at the same moment the strong draught of air setting through the gorge, nearly detached all our hats in a moment, and actually carried Balmat's over the precipice down to the glacier of Salena. We were then struck, whilst looking in each others faces, at the pinched and ghastly appearance which all presented. Both the guides looked nearly bloodless; but none of us felt unwell. We took some brandy as a precaution (probably a needless one) against the cold, and tied our handkerchiefs over our ears. Charlet now told us that when here twelve years before, he had succeeded in descending on the glacier of Salena by turning round the north side of the peak *d*, (which is partly of rock, partly of

snow, and appears to be accessible) in the direction of the glacier of Trient. In following this course, we passed between the summits *c* and *d*, and gained a point somewhat higher than the barometrical station. From D we had a view of a new glacier, or *névé*, which Charlet told us (and it is no doubt so) communicates with the glacier of Trient. It was by descending upon this first that he had gained the level of the glacier of Salena afterwards.

The question now was, should we retrace our steps to Chamouni, or push on to Orsières? Charlet feared that our non-appearance at Col de Balme or Le Tour might create uneasiness; but after some discussion it was agreed that the opportunity of proceeding was too tempting to be lost, especially as the weather appeared fine towards Val Ferret. After scarcely a minute's delay, then, we resolved to seek a safe place of descent to the level of the névé connected with the glacier of Trient, which we had to effect over an almost precipitous surface of hardened snow (which in some places presented an *overhanging* edge of alarming appearance), but which admitted of a passage at one point with little difficulty or danger. This snow cliff scarcely existed when Charlet formerly passed—an instance of the great changes undergone by the glacier regions. Being now on the level of the névé, we turned towards the right hand, and found a wall of rock cut through by a magnificent gateway, flanked by two pinnacles of highly crystalline protogine not many yards asunder, between which we passed with the greatest ease, and, descending a snow slope of no great height, we found ourselves on the névé of the glacier of Salena. The abruptness of the change and the beauty of the portal (like the *ports* of the Pyrenees, but still narrower) rendered this a very striking and peculiar pass. The basin

in which we now found ourselves is remarkably enclosed by precipitous rocks, everywhere interspersed with glaciers and perpetual snow. Our station between the peaks *d* and *e* now appeared at a great height above a most precipitous snow slope, toward which Auguste long and wistfully looked for his lost hat. Behind the peak *e*, to the westward, it appeared as if a passage might lead from the glacier of Le Tour to that of Salena, but Charlet assured us that he had formerly explored the glacier of Le Tour and found no exit in that direction. It appeared to us not impossible that a pass might exist from the head of the Glacier d'Argentière directly to the glacier of Salena, between *e* and the very white summit marked Aiguille Blanche; but my recollection of the Glacier d'Argentière is not favourable to this idea. Charlet strongly insisted that the Glacier d'Argentière does not terminate behind the Aiguille Blanche, as I thought, but, bending, stretches to the S.W. behind the summit A, which I rather conjectured to be the summit seen to the S.E. of the Jardin, and marked in my map of the Mer de Glace.

The névé of the glacier of Salena, seen from the point, or rather the snowy basin at which we were now arrived, might well appear to have no issue. The formidable barriers of rock, between which the glacier descends almost precipitously, might seem to bar a passage in the direction of the valley. From Mugnier's account (the guide of Chamouni, whom I engaged in 1846 for this excursion), it appears certain that he did not attempt to descend (his words to me, I recollect, were, "Nous n'avons pas osé de déscendre,") but he had preferred crossing the lofty range somewhere about F, by which means he arrived at the glacier of La Neuva, by which he descended near the Col Ferret. Trusting, how-

ever, to Charlet's report of what he had actually done (for the advancing afternoon left us no time for abortive attempts), we resolved to descend as much as possible by the Glacier de Salena. We accordingly secured ourselves once more together by ropes, and soon came amongst newly opening crevasses as we approached the gorge which offered the great obstacle to our passage. We resolved to retreat to the left bank of the glacier, and to dine on the rock at K, near abundant streams of snow water descending from a glacier connected with the heights above us on the left, amidst a perfect chaos of stupendous blocks of the finest granite, or rather protogine, anywhere to be seen in the Alps. This was at 3h. 10m.; at 3h. 45m. we were ready to start, and again used the ropes for a short space, but, soon clearing the snow, we abandoned them, and following for a little way the left bank of the glacier, as it got steeper and steeper, and began to break into wider crevasses, Auguste volunteered to go on and see whether it might be possible to effect the descent over the broken ice. As we more than anticipated, however, he returned to say that it was quite impracticable, and that, therefore, we must submit to clamber over rocks to a great height above the right bank, and to pass beneath the small glaciers G G, which was not unattended with danger, in event of stones rolling from them. We first crossed the main glacier without much difficulty, and could now inspect those small glaciers of the second order, which seemed almost to overhang the path we must follow, so steep was the mound of debris which stretched from their foot. We could distinctly see stones on their upper fronts, but the guides pronounced them apparently safe, and recommended the precaution merely of mounting the slope of debris, and slanting over to the

shoulder of rock H as rapidly as possible. It was a fatiguing but a short effort, and the risk I should say was inconsiderable, at least in the then condition of these glaciers. The summit of the rocky shoulder II was strewed with enormous blocks, tossed in confusion, shattered and bruised by the mutual shocks which they had evidently undergone no further back than last spring, when they had thundered down with the early thaw, from the upper level of the little glaciers. At present, however, there was no danger, and we paused a while for breath.

We were now at a great height above the glacier of Salena, not only on account of the ascent which we had made, but also from the steep fall of the glacier in a contrary direction. Having passed the summit of the knoll which had formed the great obstacle, we were now to seek a safe descent to the main glacier once more. This would have been, in all probability, a matter of small difficulty, had not the fogs which all day had been hovering on the summits, suddenly descended at 5 p.m., and enveloped us almost without warning. Our position was not free from anxiety, for it was impossible to see more than 30 or 40 yards in any direction. Charlet continued to advance until we found a small steep glacier in front of us, descending from the heights above, and completely barring passage in a forward direction—(it is shewn at I in the sketch, p. 335). We then attempted to descend the rocky ridge upon which we found ourselves, which fell steeply towards the main glacier, but a moderate distance brought us to impracticable precipices. In these circumstances, only two courses remained open, either to wait for the rising of the fog, or to descend from the rock upon the moraine and rubbish which bordered the small glacier,

and then attempt to scramble down it. We followed the latter course, and our descent was facilitated by long snow inclines, over which we slid rapidly; whilst so engaged, the fog happily cleared for a few minutes, revealing our entire position, and giving us an opportunity of resolving on our ultimate route, for we knew that sooner or later we must cross the main glacier. Fortunately we had selected what appeared to be the *only practicable descent.* On the one side of us was an impassable glacier, on the other impassable cliffs. Having made very rapidly a great descent, we diverged to the right, passing (at a safe distance) under the termination of the small glacier, and soon after reached the level of the glacier of Salena without difficulty, which we also crossed with no great delay. We had then a tedious descent over rough moraines, here and there diversified by patches of the most superb vegetation, till we came to a torrent which we understood to descend from the glacier of Orny, where we halted for a short time at 6h. 45m. This stream we also crossed without difficulty, and had now reached the limit of trees; we had a stony and laborious descent through woods nearly pathless before we came to a certain track. By this time we had passed the termination of the glacier of Salena, which we saw distinctly below us. Amidst the wood were vast blocks of the granite of Orny, and, looking back, fine views of the glacier we had left; but the mists were *again fallen below the level of the place of our perplexity*, so that, but for the momentary rise, we must have remained in much anxiety. At 7h. 55m., we reached the village of Praz de Fort, in Val Ferret, close to the remarkable moraine which protrudes into the valley, and which attracts the attention of all travellers. An hour's sharp walking brought us to Orsières,

which we entered at 9 p.m., 12½ hours from the Col de Balme.

The junction of protogine and gneiss, on the north side of the glacier, appeared to be not very far above our ingress on the glacier of Le Tour. On the south side, the gneiss formation is comparatively narrow; I did not notice the junction accurately, being too happy at our escape from the fog to think of anything else; but I believe that it was near the point where we crossed the glacier of Salena after our rapid descent. The calcareous schists appeared in the wood on our left, some time before reaching Praz de Fort.

INDEX.

Aalesund, 100.
Aardals-fiord, 175.
Aar, Lower Glacier of the, 297, 299; Upper Glacier, 300, 305.
Agassiz, M., 297, &c.
Agriculture in the Arctic Circle, 54.
Aletsch, Glacier of, 300, 314; its structure and blue bands, 326; its inferior termination, 328; Lake of, 310, 314.
Allevard, Baths of, 261.
Alps, Journals of Excursions in the, 255, &c.
Alps, the Bernese, 296; views of, 301.
Alstahong, 49.
Alten, snow-line at, 209.
Alten-fiord, 85; Alten river, 93.
Alversund, 105.
Ancient climate of Norway, 242, &c.
Ancient glaciers—See Glaciers, ancient.
Arendal, coast near, 1.
Aurlands-fiord, 146.

"Bauta" stones, 148, 153.
Balme, Col de, 332; its height, 336.
Bergen, arrival at, 106; its inhabitants, 106; trade, 107; museum, 108; its insulation from the rest of Norway, 109; its environs, 110, 122; its climate, 111, 112, 215.
Bergs-fiord, Glacier of, 80.
Bernese Alps, glaciers of the, 296, &c.; their grouping, 299; panoramas of, 301.
Bensjordstind, mountain and glacier, 66.
Biddulph, Captain, 221, 222, *note.*
Birch, limiting level of, in Norway, 212, 214.
Blaamands-field or Almajalos, 56, 230.
Bodö, 53.
Bondhuus, hamlet, 130; valley of, 131, &c.; moraines near, 131; glacier of, 133.
Börge-field, 226.
Borgund, church at, 181.
Bosekop, 84, 93.
Bourg d'Oisans, 264.
Bravais, M., 89.
Brönö, 47.
Buch, L. von, 30, 37, 123; on the limits of vegetation, 211.
Buer, Glacier of, 221.

Cairngorm, 25.
Carriole or Kariole, 6.
Celar, Col de, 283.
"Chains" of mountains seldom continuous, 197, 198.
Chambers, Mr. R., 89, 241.
Chamouni, passage from, to Val Ferret, 330.
Christiania, the capital of Norway, 3; its climate, 5; university, 5; return to, 184; population, 5.—See *Additions and Corrections.*
Christiansund, 99.
Climate of Norway, 198, &c.; ancient, 242.
Climate of Christiania and Bergen compared, 111; of Alten, 88.
Cloud, majestic, seen from the Jungfrau, 322.

Condamina, Glacier de la, 275.
Crevasses, enormous, 308, 317.
Crowe, Consul, 85, 231, *note.*

Dauphiné, excursions in, 255, &c.
Desiderata on the Physical Geography of Norway, 245.
Diallage, 96, 123.
"Dirt bands" on glaciers, 163; at Krondal, 166.
Dovre-field, 15, &c; limit of pine, *ib.;* traces of ancient glaciers, 24, 27; geology, 33; snowfields, 225.
Drivstuen, 31.
Durocher, M., on the Glaciers of Justedal, 160, 161, *note.*

Eclipse, total, of the sun at Bergen, 113, &c.; ancient total eclipse at Stiklastad in Værdal, 116; other total eclipses, 118.
Elevation, alleged crater of, 259; axis of, 294.
Elie de Beaumont, M., 259, 292, &c.
Esmark on the Ancient Glaciers of the Sogne-fiord, 103, *note,* and of Norway in general, 237.
Excessive climates, 200.

Fields or Fjelds, 191.
Fieldstuer, 32.
Fillefield, Pass of the, 181; snow line, 208.
Finmarken, 68.
Finns, 96.
Finsteraarhorn, glaciers adjoining the, 299.
Firn or *Névé,* 305, *note;* crevasses in the, 308.
Fjærland, 149; glaciers of, 150, 223.
Færder, island of, 3.
Folden-fiord, 57.
Folgefond, snowfield of, 128, 136, 140, 220; its height, 138.
Fondalen, glaciers of, 52, 227.
Forbud-Seddel, 7, 124.
Fureberg waterfall, 129.

Galdhöpiggen, Store, the highest mountain in Norway—see Ymes-field.
Geology of Dovre-field, 33; of Kaafiord, 95; near Bergen, 123; of Närœdal, 145; of Sogndal, 155.
Geology of the mountains of Dauphiné, 259, 276, 288, 294.
Geological agency of glaciers, 237, &c.
Glaciers and snowfields of Norway described, 217, &c.; the conditions of their ancient extension, 242, &c.
Glaciers, modern, in Norway, referred to by Pontoppidan, 218; synonymes of, 218;—at Snechättan, 21, 225; Fondalen, 52, 227; Sulitelma and Blaamands-field, 56, 228; in Lofodden Islands, 63-65, 230; in Andorgö, 66; Bensjordstind, 66; Ringvadsö, 74; Jägervandstind, 75; Pippertind in Lyngens fiord, 75; Reendalen, 76; Kaagen, 77; Jökuls-field, 78, 231; Bergs-fiord, 80; Nus-fiord, 81; Bondhuus on the Hardanger, 133; Folgefond, 136, &c.; at Fresvig (?), 147; Fjærland, 149, 223; Suphellen, 150; near Sogndal, 155, 223; of Justedal, 160, &c., 223; of Lodal, 161, *note,* 224; dirt bands of, 163, 166; of Krondal, 163, 224; of Nygaard, 167-224; of Buer, 221; Matre-fiord, 221; of Hallings Jökulen, 222; of Brendendal, 224, *note;* Börge-field, 226; glaciers of Norway and Switzerland compared, 232.
Glaciers, modern, in the Alps—La Condamina, 275; of the Col de Celar, 283; of La Grave, 289; of the Lower Aar, 297, 299; Upper Aar, 300, 305; of Viesch, 300, 308; of Aletsch, 300, 314, 326-8; of Le Tour, 331; of Salena, 335.
Glaciers of Himalaya, 163, 240.
Glaciers, laws of their motion and its cause, 234, 235.
Glaciers, ancient traces of—on Dovre-field, 24; at Vaarstige, 27; at Torghattan, 45; at Folden-fiord, with some remarks on ancient glaciers generally, 58; in Lofod-

den, 64; in Alten, 91; entrance of Sogne-fiord, 102, 103; remarkable observation of Esmark respecting, 103, *note;* at Logsund, 126; at Svoldal on the Hardanger, 129; moraine at Sogndal, 155; polished rocks in Justedal, 166, 174; Esmark on the Ancient Glaciers of Norway, 237; Moraine of Vasbotten, 239; Can all the phenomena be thus accounted for? 241.
Glière, Aiguille de la, 330, 332.
Godemar, Val, 280.
Gousta-field, 220.
Granite, its superposition to lias in Dauphiné, 288; of Orny, 342.
Grimsel Hospice, 296, 303.
Gudvangen, 145.
Gulbrandsdal, 10.
Gulf-stream, the, 201, 202, 245, *note.*

Hallings Jökulen, Glaciers of, 222.
Hammerfest, 83.
Hardangerfield, 208, 221.
Hansteen, Professor, 116.
Heath, Rev. J. M., 257, 296.
Hebrides, Norwegian coast compared to the, 2.
Hestmandö, 51.
Himalaya, glaciers of, 163, 240.
Hindö in Lofodden, 64.
Horneln, cliffs of, 101.

Iceland, snow line and climate of, 243.
Infernets, Col des, 293.
Isothermal lines, 199, 201.

Jerkind, 17.
Jökuls-field, glaciers of, 79, 81.
Jungfrau, ascent of the, 312, &c.; description of the summit, 321.
Justedal, approach to, 158; church and parsonage, 159; height of, *ib.;* Glaciers of, 160, &c., 223.
Justedals Bræen, 149, 160, &c., 223.

Kaa-fiord, 85; climate of, 87; geology of, 95.
Kaagen, Island and Glacier, 77.
Keelfoss, 145.
Kirkwall, 4.
Kjerringö, 57.
Kjölen or Koelen Mountains, 40, 193, &c.
Klöven, 66.
Krondal, 162; Glaciers of, 163, &c., 224.
Kunnen, remarkable headland, 53.
Kvindherred-fiord, 127.

La Berarde in Dauphiné, 270.
La Chapelle in Dauphiné, 279.
La Grave, village in Dauphiné, 290; Pic du midi de, 288; Glacier de, 289; views from, 291, 292; its height, 293.
Lapps, visit to, 70, &c., Lapp races, 96, 97.
Lærdalsören, 176.
Lautaret, Col de, 288.
Lekanger, 147, 148.
Lindesnaes, 1.
Leuthold, Jacob, the guide of Hasli, 303, &c.
Leprosy, 110.
Lodal, Glacier of, 161, *note;* 224.
Lodals-kaabe, 160, 161, *note.*
Lofodden Islands, extraordinary prospect of, 60; fishery at, 61; glaciers, 230.
Logsund, 125; glacier markings, 126.
Lougen River, 10, 11.
Lous, Captain, 42, 114.
Lovunden and Threnen Isles, 50.
Lyngen-fiord, 74.

Mackintosh, Mr. John, 296.
Maurienne, St. Jean de, 293.
Märjelen, châlets of, 310.
Matre-fiord Glacier, 221.
Meteorology of Alten, 87.
Meteorology of Norway, desiderata, 247.
Meyers, their ascent of the Jungfrau, 312.
Midnight in the Arctic Circle, 53, 79.
Mineral waters of Dauphiné, 260.
Miösen Lake, 9.
Miösen, Little, Lake of, 182.
Molde, 100.
Moraines, 131; see *Glaciers,* ancient traces of.

Moraine at Sogndal, 155; at Vasbotten, 239; at Praz de Fort, 342.
Moranger-fiord, 129.
Munch, Professor, 192, 222, 224, 228, *note*, and elsewhere.

Nargla, standing stones at, 154.
Närœdal, 145; Närœ-fiord, *ib.*
Naumann, 33, 123, and elsewhere.
Nordland, 47.
"Norit" formation, 144.
Norway, physical geography of; see Physical Geography;—sections of, 197.
Nus-fiord, glaciers of, 81.
Nygaard, Glacier of, 167, 224; its immense increase in 1740, 169; character of its ice, 171, &c.

Oberaar Glacier, 300, 305; Col of, 306.
Oerkel River, 35.
Oevrehuus, 134.
Œxtind, 51.
Oisans, Mountains of, 258, &c.; Bourg d'Oisans, 264.
Olaf, death of King, 117.
Oos, 123.
Orny, granite of, 342.
Orography, 187; of Norway, 189.
Orsières, arrival at, 342.
Oxe-fiord, 82.

Pelvoux, Mont, 277, 286.
Perpetual snow in Norway, 207.
Photometrical observations, 69, 80, 85.
Physical Geography of Norway, 185, &c.; Configuration, 189; on some peculiarities of the climate, 198; on the position of the snow line, 205; enumeration of the principal snow fields and glaciers, 217; its glaciers compared with those of Switzerland, 232; the former extension of glaciers, 237; observations to be made, 245; on some peculiarities of the scenery, 248.
Pic du Midi de la Grave, 288.
Pilotage in Norway, 104.
Pippertind glacier, 75.
Plasticity of glaciers, 172, 235.
Pontopiddan, Bishop of Bergen, 108, 182, *note;* 193, *note;* 199, 218.
Posting in Norway, 7, 124, 177, &c.

Quaens, the race of, 96, 97.
Quaenvig, 91; grooved rocks, 91.

Rafte-sund, 63.
Rain in Norway and Sweden, 203; at Alten, 89; at Bergen, 112; in Norway and the Alps, 233.
Red snow, 307.
Reipas, 94.
Ringerige, 184.
Ringvadsö, 74.
Roads in Norway, how maintained, 29.
Rödö, 52.
Rönneid on the Lyster-fiord, 157.
Roth-thal, 318.
Rousses, Les Grandes, 258, 291.

Sais, Col de, passage of the, 275, &c.; its height, 277.
Salena, Col de, 330, 334; its height, 336; Glacier de, 335, &c.
Salten-fiord, 54.
Scenery of Norway, remarks on the, 8, 248.
Sections of Scandinavia, 197.
Seiland, 83.
Seven Lakes, the, in Dauphiné, 262.
Seven Sisters, mountain of the, 49.
Skjærvö, 76.
Smith, Christian, the Norwegian botanist, 219, 222, and elsewhere.
Snow fields and glaciers of Norway enumerated, 217, &c.
Sneehättan, 16, 19; ascent of, 20; glacier of, 21, 225; height of, 22; view from, 23; snow line, 226.
Snow line in Norway, 205; mainly determined by the summer temperature, 206; tabular results, 212, 214; snow line in Iceland, 243.
Sogne-fiord, 146, &c.; entrance of, 102; its glacier markings, 103, and *note.*
Sogndal, 154; moraine near, 155; geology of, *ib.*
Solvorn, 156.
Sör-fiord, 139.

St. Christophe, valley of, 266; village of, 269.
Stadt, headland of, 101, 196.
Stalheim, 144, 145.
Steamers, Norwegian, 104.
Stejlo in Lofodden, 62.
Stiklastad, total eclipse of A.D. 1030 at, 116.
Stjernö, 83.
Storelv, valley of the, 158.
Storfond, 222.
Storthing, 5.
Studer, Mr. G., 325.
Suledals, or Bykkle-field, 220.
Sulitelma, range of, 55, 228; snow line near, 209.—See *Additions and Corrections;* glaciers of, 228.
Summer heat in Norway, 203; mainly determines the snow line, 156.
Suphelle Glacier, 150, 223; its remarkably low level, 151.
Sweden, the climate more continental than in Norway, 203.
Switzerland, its glaciers compared to those of Norway, 232.

Talvig, 83.
Temerity of a guide, 317, *note.*
Teroe, a water station, 126.
Terraces at Throndhjem, 37; at Altenfiord, 89; at Quaenvig, 91; at Aalesund, 101; at Lækanger, 148.
Throndhjem, 36, 99; cathedral, 36; terraces, 37; climate, 38; its position with reference to the geography of Norway, 39-41.
Throndhjems-fiord, 43, 99.
Tofte, 13.
Torghattan, its cavern, 44; glacial action on, 45.
Tour, Glacier du, 331.
Travelling in Norway, 6, 124; in spring time, 30.
Tromsö, 68.
Trugberg, near Jungfrau, 315.

Ulfs-fiord, 74.
Ullensvang, 140.
Uriage, baths of, 261.
Utne, 141.

Vaagö in Lofodden, 63.
Vaarstige, 26-31; glacier markings of, 27.
Værdal, eclipse at, 116.
Vaers, 43.
Valders, 183.
Val Louise in Dauphiné, 285.
Vegetation at Christiania, 5; in lat. 66°, 55; in lat. 70°, 91; at Bergen, 122.
Vegetation, limits of in lat. 70°, 211.
Veined structure of glacier ice, 173, 326.
Vetties Giel, savage scenery of, 175, *note.*
Viesch, Glacier of, 300, 308.
Villages, absence of in Norway, 12.
Vinje, 144.
Vossevangen, 141.

Wahlenberg, 209, 218, and elsewhere.
Wasenhorn, panorama of the, 301.
Waterfalls, as elements of scenery, 249; cause of their profusion in Norway, 251.
Waterfall of Fureberg, 129.
Wittich, Mr., quoted, 221, 232.

"Yachts," Norwegian, 48.
Ymes-field, 22, 157, *note,* 175, *note;* glaciers of, 225; map of, *ib.*

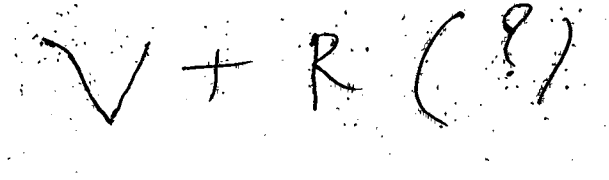
EDINBURGH: PRINTED BY R. AND R. CLARK.


SKETCH MAP SHEWING THE RELATIVE POSITION & CLIMATE OF NORWAY.

NORWAY.

Scale of English Miles
Norwegian Miles


00085590



Digitized with financial assistance from the
Government of Maharashtra
on 23 March, 2016